System Design Standards

Prepared By:

The JCSUD Engineering Department

2023

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The following design standards are intended to aid Johnson County Special Utility District (JCSUD) in arriving at a uniform design for the construction of water and wastewater utilities in the JCSUD service area. In most cases, there are circumstances that will be considered should the designer see a need to vary from these standards. Request for variances from these standards shall be presented to JCSUD for consideration. Variance consideration by JCSUD does not constitute or guarantee acceptance or approval.

Approved By:

Tyler Lyles
Water Operations Manager

James Lyles
Wastewater Operations Manager

Dana Collier, CPM
Deputy General Manager

Jeremiah Bihl, PE, PMP
District Engineer

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System Design Standards

Revision Tracking Table

Revision #	Section #	Paragraph #	Description	Date
1	1	1.2	Added water quality sampling station standards to sections 1.2.2 and 1.2.4	05/08/2023
2	1	1.4	Updated Approved Parts List to include Bluetooth Controller for Automatic Flushing Stations	05/12/2023
3	1	1.1 and 1.4	Added a reference for the valve extensions in section 1.1.8. Updated Approved Parts List to include valve extensions in section 1.4.	06/09/2023
4	1	1.10	Added a note about backgilling trenches needing to meet standard specifications of North Council of Governments unless approved otherwise in section 1.1.10	08/07/2023

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Section 1 – Water Design Standards

1.1 Minimum Design Standards For Water Distribution

1.1.1 General

A) All water distribution system design shall be in accordance with the requirements of TCEQ Chapter 290, AWWA Standards and JCSUD's Design Standards for Water Distribution.

1.1.2 Waterline Classification and Sizes

A) Waterline Size Classification
   1) Distribution mains are classified as waterlines having at least one customer service tap.
   2) Transmission mains are classified as waterlines having no customer service taps.

B) Water Mains Sizes:
   1) The standard minimum pipe size for distribution mains shall be 8-inch.
   2) For a subdivision development in Pressure Planes 03, 05, 09, 10, 18, 19, 24, and 25 or those that have only ground pumping facilities, and the development is not subject to fire flow requirements, a 6-inch water line is allowed.

1.1.3 Waterline Material

A) Distribution mains 6-inches to 12-inches in diameter shall be AWWA C900 DR-18 PVC pipe.
B) Distribution lines equal to or greater than 16-inches in diameter shall be ductile iron pipe.
C) Transmission lines equal to or smaller than 16-inches in diameter shall be AWWA C900 DR-18 PVC pipe.
D) Transmission mains equal to or greater than 20-inches in diameter shall be ductile iron pipe
E) All pipe must meet the requirements of ANSI/NSF 61.
F) Pipe material must be clearly identified on the plans.
G) Use **Table 4 – JCSUD Approved Parts** in subsection **1.4** as a reference for approved piping materials.

1.1.4 Typical Waterline Layout

A) Water mains shall be at a minimum depth of 42-inches.
B) Water mains shall be located within a 20-foot wide JCSUD easement on private property immediately adjacent and parallel to the right-of-way line.
   1) The 20-foot requirement may be adjusted if the water mains are in a subdivision.
C) Water mains shall typically be located on the uphill and opposite side of the street of sanitary sewer mains.
D) Waterlines shall not be installed closer than 10-feet to a septic tank drain field.
E) Water mains shall be designed as looped systems, except as specified herein.
F) Where a water main crosses a street or railroad right-of-way, the crossing shall be made perpendicular or as near to perpendicular as possible.
G) The minimum radius of curvature and maximum deflection angle of pipe joints shall be restricted to 75% of the manufacturer's recommendation.

1) Radii of curvature and maximum deflection angles greater than 75% of the manufacturer's recommendation must be approved by JCSUD.
2) If not approved, the use of horizontal or vertical bends will be required.

H) Water mains shall extend to the furthest limits of the platted property or the subdivision served, and further when required to tie into existing mains beyond the limits of the development.

I) Cul-De-Sacs
1) When cul-de-sacs are designed within a subdivision the water line shall be reduced to 4-inch once the radius begins or after the last hydrant, unless deflection of the originally designed pipe size can be properly achieved without exceeding 75% the pipe manufacturer's recommendations.
2) A 45° bend may be attached to the reducer using a foster adapter to help achieve the radius that is needed.

J) Dead-end Mains
1) Dead-end mains must be approved by JCSUD.
2) Where dead-end mains are permitted, they shall be designed such that:
i) The system may be periodically flushed by use of an automatic flush valve or fire hydrant.

1.1.5 Waterline Construction Standards

A) Pipe restraints and reaction blocking shall be constructed per JCSUD standard details.

B) If unusual or non-typical soil conditions are encountered or reasonably expected to be encountered during pipe installation, the design engineer shall provide calculations and sizing for restraints and blocking at the request of JCSUD.

C) Waterline and sanitary sewer line crossings shall meet the requirements of Texas Commission on Environmental Quality (TCEQ) Chapter 217.53.

D) Waterlines and sanitary sewers shall be installed no closer to each other than 9-feet and where this cannot be achieved, the sanitary sewer shall be constructed of SDR 26 (ASTM D2241) 160-psi pressure pipe with watertight joints.

E) All pipes laid will have tracer wire. The wire shall be solid copper, at least #12 AWG or larger with blue insulation.

1.1.6 Waterline Connections

A) Tapping Sleeves / Saddles
1) As approved by JCUSD, smith-Blair model 663 tapping valves may be used for connections to existing mains in order to avoid interruption of water service.
2) Approval for tapping sleeves/saddles will be on a case-by-case basis.
3) Size-on-size taps are not allowed.

B) Typical Cut-In Tees
1) All cut-in tees will have a 3-valve cluster.

C) Flanged Outlets
1) All fitting-to-fitting or fitting-to-valve connections shall be flanged or flanged to Mechanical Restrained Joint (MJ).
2) All main line tie-ins must have a flanged tee with 3 flg x MJ valves.
3) A stainless-steel tapping band with flange and flange x MJ valve may be installed to facilitate a wet tap with prior JCSUD approval.

1.1.7 Waterline Fittings

A) Main Line Fittings With No Attached Valves or Fittings
   1) All tees, wyes, plugs, caps, reducers, crosses, and bends shall be ductile iron with a mechanical connection on lines 3-inches or larger.
   2) MEGA-LUG or STARGRIP restrained glands shall be used on all pipe connections, fittings, plugs, and flush valves in addition to concrete blocking.

B) Main Line Fittings With Attached Valves or Fittings
   1) All tees, wyes, plus, caps, reducer, crosses, and bends shall be ductile or cast iron.
   2) MEGA-LUG or STARGRIP restrained glands will be used on all pipe connections to the mechanical joint adapters.
   3) A 20-foot piece of pipe will be used out of all fittings, unless otherwise approved by JCSUD.
   4) When a vertical transition utilizing 45°degree bends is required, ductile iron pipe and all thread will be used in between the two 45°degree bends.

1.1.8 Valves

A) Gate Valves
   1) Gate valves shall be designed for a minimum water working pressure of not less than 350-psi.
   2) Valves shall be installed in a 3-valve cluster at all waterline intersections.
   3) Valves installed deeper than 3 ½ - feet to the top of the operating nut, will have a valve extension made and installed to facilitate operation of the valve with a standard valve wrench.
   4) Refer to **Table 1.4 – JSUD Approved Parts** in subsection **1.4** as a reference for approved valve extensions.
   5) For distribution mains, valves shall be placed as specified below.
      i) Valves shall be located between each tee, cross or other junction such that each leg can be isolated independently.
      ii) In-line valves shall be located such that no more than two fire hydrants are out of service when a single-leg main is located or at a maximum of 1000-feet between valves, whichever is less.
      iii) Transmission mains 16-inch diameter and larger shall be equipped with valves at ½ mile intervals unless it is determined that more valves are required.

B) Air Relief Valves
   1) All air relief valves shall be A.R.I D-040-C 1 and be set at the places designated by JCSUD.

C) Flush Valves
   1) Dead end lines shall have an automatic flush valve at the end of the line.
   2) Automatic Flush Valves shall be designed per **JCSUD Standard Detail VL-200.**

D) Valve Boxes
   1) Valve boxes shall be cast iron with cast iron lids.
   2) If the valve box needs an extension to reach the surface then a piece of ductile iron pipe must be used, PVC pipe is not allowed.
   3) A 24" x 24" x 6" concrete pad shall be poured around all valve boxes.
      i) **See Detail VL-100.**

1.1.9 Service Taps, Service Lines and Meters

A) Domestic water service shall be provided from right-of-way or dedicated JCSUD utility easement adjacent to the property being served.

B) Water meters shall be located on the property being served and shall typically be positioned 5-7-feet from the edge of the property line of the property to be served.

C) Water meter location may be adjusted based on lot density and may be positioned closer to the edge of the property.

D) No portion of a service line shall be allowed to cross property boundaries into adjacent property.

E) Water service connections are as follows:

Table 1 – Meter Sizes

Meter Size	Tapping Saddle & Corp. Size	Approximate Maximum Flow (GPM)	Service Line Size (Main to Meter)
5/8" x ¾"	1" TS / ¾" CS	20	3/4" , 1" for long service
¾"	1" TS / ¾" CS	30	3/4" or 1" for long service
1"	1"	55	1"
2"	2"	250	2"
3"	3"	500	3"
4"	4"	1000	4"
6"	6"	1,600	6"

F) All tap saddles must be 1-inch CC threaded or 2-inch iron pipe threaded Smith-Blair Style 317.

G) For short single services, the service must be reduced to ¾-inch at the saddle using 1-inch x ¾-inch brass bushing.

H) For long single services, the service must be 1-inch and then reduced to ¾-inch at the property line.

I) All tapping sleeves must be Smith-Blair model 663.

J) Use **Table 4 – JCSUD Approved Parts** in subsection **1.4** as a reference for the approved service lines and meters

1.1.10 Backfilling Trenches

A) All construction materials, methods, and placement shall meet or exceed the standard specifications of North Central Council of Governments 5th edition unless superseded by JCSUD standard specifications or material testing policies.

B) Trenches shall be backfilled to a horizontal plane 6-inches above the top of the pipe and pipe bells with sand consisting of clean, durable, uncoated grains free from lumps and organic material.

C) Native material from the trench excavation may be used after the sand embedment if:

1) the native material contains no rocks larger than 3-inches in diameter or clay lumps larger than 6-inches in diameter.

D) Topsoil that was removed in the top 6-inches of the pipe shall be stored separately and placed in the top 6-inches of the trench.

E) Water distribution mains shall have a minimum cover of 42-inches from the top of the pipe to the finished ground surface unless approved by JCSUD .

F) All water mains shall be laid at uniform depth, avoiding excessive or dramatic high and low points.

G) Pipe bedding and embedment shall be in accordance with JCSUD Specifications.

H) Trench Safety

1) In accordance with various State and US Government laws and regulations, whenever trench excavations exceed a depth of 5-feet, a trench safety system will be required.

2) The trench safety system must be developed and installed to meet the requirements of both State and U.S. government laws and regulations.

1.1.11 Fire Protection Requirements

A) Fire protection must comply with the JCSUD fire flow policy.

1) Check the JCSUD fire flow policy for details.

B) Fire Service Lines:

1) The double-check detector assembly shall have a JCSUD approved 5/8" x ¾" low flow detector check meter installed.

i) See Standard Water Details for vault construction.

2) Refer to **Table 4 – JCSUD Approved Parts** for approved vaults.

C) Fire Hydrants

1) Fire hydrants shall be located in an easement near the waterline in subdivisions.

2) When a fire hydrant is to be installed on private property, an easement shall be dedicated to JCSUD.

3) JCSUD shall approve the location of all new fire hydrants.

4) Fire hydrant leads shall be a minimum of 6-inches in diameter and mechanically restrained at the tap/tee and the hydrant.

5) Fire hydrants shall be placed at 1,000-ft spacing or follow the governing entity spacing requirements.

6) Additional fire hydrants may be required based on the length of cul-de-sac.

7) Fire hydrants placed at the bulb end of cul-de-sacs should be avoided.

8) Fire hydrants shall be installed and maintained so that the center of the lowest water outlet is between 18- 24 inches above the ground.

9) Fire hydrants in parkways shall be placed so that they are readily visible from the street and be between 18-inches and 3-feet from the back of the curb.

10) No bushes, ground cover over 6-inches in height, or other obstructions shall be placed within a 5-foot radius in all directions of a hydrant or fire department connection.

11) Where fire hydrants are vulnerable to vehicular damage, steel bollards shall be installed.

12) Bollards shall be 4-inch, cement-filled pipe with a minimum of three feet above finished grade and two feet of pipe anchored in concrete below grade.

13) No obstructions shall exist within a 3-foot working area of each fire hydrant.

14) Fire hydrants shall not be installed on main lines less than 6-inches in diameter.

15) Distances between installed fire hydrants shall not be more than 1,000-feet.

16) Hydrants will be either a Mueller Super Centurion 250, Clow Medallion, American Darling HB-84-B or M&H Style 129.

17) All fire hydrants shall conform to ANSI/AWWA C 502 compression type, 150 working pressure traffic model, and dry top unless otherwise specified.

18) All fire hydrants will be painted at the factory and set level and plumb.

19) Hydrants capable of providing 1,000-gpm or greater of fire flow shall be painted red.

20) Hydrants not capable of providing 1,000-gpm fire flow shall be "fill-only" and painted black.

21) An 18-inch anchor coupling shall be used to connect the hydrant to the valve.

22) If a lead is approved by JCSUD, the lead must be C-900 PVC and be one solid piece from the valve to the fire hydrant.

23) A suitable support and thrust block will be installed to support the hydrant. The drainage holes will not be blocked by the thrust block or the support.

1.1.12 Bores and Crossings

A) All crossings are bored unless otherwise noted and approved by the governing entity.

B) Only straight pipe alignments for both horizontal and vertical alignments are allowed.

C) Casing shall extend the entire width of the right-of-way or as approved by JCSUD and any other governing agency.

D) Casing pipe shall be a minimum of 4-inches in diameter greater than the outside diameter of the nominal pipe.

E) Steel encasement thickness shall be:

Table 2 – Steel Encasement Thickness

Casing Diameter	Minimum Casing Thickness
<16 inches	3/8 inch
≥16 inches	½ inch

F) Steel encasement pipe shall have a minimum yield strength of 35,000-psi and be coated in accordance with the latest revision to AWWA Standard C302 or C214.

G) Manufactured centralizers or spacers must be used at a minimum of 5-feet intervals, with a spacer being located a maximum of two feet from each joint, or as the manufacturer recommends.

H) Only approved centralizers and spacers shall be used.
    1) See **Table 4 – JCSUD Approved Parts** for reference.

I) For bores in excess of 100-feet, approved fused or restrained-joint pipe shall be used.

J) Slick boring or directional drilling without encasement shall be considered on a case-by-case by the Operations and Engineering Department.

K) Care shall be taken to minimize the annular space between the cased or uncased pipe and the earthen walls of the bored hole. Annular space that consistently exceeds 1-inch and/or reasonably poses a hazard to the integrity of structures above shall be injection grouted, as determined by the Operations and Engineering Department.

L) Highway and Railway Crossings
    1) All bores will conform to the requirements of the entity that controls the roadway where the work is taking place (TXDOT, County, or City).
    2) All bore encasement pipe sizes will be determined in **Table 3**.
    3) The exterior of the pipe will be coated in accordance with the latest revision to AWWA Standard C203 or AWWA Standard C214.

Table 3 - Bore Encasement Pipe Sizes

Material	Nominal Pipe Diameter (inches)	Minimum Trench Width (inches)	Steel Encasement Diameter (inches)	PVC Encasement Diameter (inches)
PVC	4	21	10	10 SDR 35
PVC	6	24	12	12 SDR 35
PVC	8	27	14	15 SDR 35
PVC	10	30	16	18 PS 46
PVC	12	33	20	21-PS 46
PVC	16	36	24	24-PS 46
D.I.	8	27	14	12 SDR 35
D.I.	10	30	16	18 PS 46
D.I.	12	33	20	21 PS 46
D.I.	14	33	22	21 PS 46
D.I.	16	36	24	24 PS 46
D.I.	18	35	26	27 PS 46
D.I.	20	37	28	27 PS 46
D.I.	24	42	32	30 PS 46
D.I.	30	48	34	36 PS 46

M) All bore encasement pipes will be a minimum internal diameter 4-inches greater than the outside diameter of the nominal pipe.
    1) PVC encasement pipe shall be SDR-35 PVC pipe.
    2) Steel encasement pipe will be a minimum pipe thickness of 3/8-inch and shall have a minimum yield strength of 35,000-psi.
    3) All gaskets must be installed.

N) All pipe bores shall also meet the following criteria:
    1) The top of the casing will be a minimum of 60-inches below the lowest surface elevation.
        i) Surface elevation could vary at times depending on the jurisdiction.
    2) The pipe will be separated from the casing by CCI Model CSS12 Stainless Steel spacers installed in accordance with the recommendations of the manufacturer.

3) The ends of the casing will be sealed with Espansit end seals installed in accordance with the manufacturer's recommendations.
4) The encasing pipe will not be sloped more than 1/8-inch per foot of casing.
5) No open cuts will be made on State Roads within 12-feet of paved surfaces unless written authorization is received from the Texas Department of Transportation.
6) On all other crossings, no open cuts will be made within 5-feet of paved surfaces unless written authorization is received from the political jurisdiction that owns the road or the property owner.
7) Open cuts for railroads must be shown on the plans.

O) Driveway Crossings
1) All paved driveways shall be bored unless approved by JCSUD. All bore encasement pipes will be sized according to **Table 3**.
2) The encasement pipe will be SDR-35 PVC pipe. All gaskets will be installed.
3) The top of casing will be a minimum of 42-inches below the lowest surface elevation.
4) The maximum depth below the lowest point will be 60-inches unless otherwise approved by JCSUD.
5) If a bore is longer than one pipe joint, then the pipe will be separated from the casing by CCI Model CSS12 Stainless Steel spaces installed in accordance with the recommendations of the manufacturer and contain spacers.
6) The encasing pipe will not be sloped more than 1/8-inch per foot of casing. On all other crossings, no open cuts will be made within 5-feet of paved surfaces unless written authorization is received from the property owner.

P) Service Lines
1) All pipe bores or road crossings for service lines 1-inch or smaller in diameter shall conform to the following criteria:
i) All piping for service line road bores and road crossings for single or dual meter sets will be 1-inch SDR 9 Poly with 1-1/2 inch schedule 40 glued PVC pipe as encasement, using a long slip coupling to piece together.
ii) All other encasement pipes will be a maximum internal diameter 1-inch greater than the outside diameter of the service pipe diameter.
iii) The top of the casing will be a minimum of 42-inches below the lowest elevation unless approved by JCSUD.
iv) Max depth for a service line shall be 54-inches.
v) The encasing pipe will not be sloped more than 1/8-inch per foot of casing.
vi) No open cuts will be made within 2-feet of paved surfaces unless written authorization is received from the political jurisdiction that owns the road. Adjustments to these standards need to be approved by JCSUD or another governing agency.
vii) All service line road bores for service lines shall conform to the criteria for Highway and Railway crossing bores.

Q) Gas Line Crossings
1) All gas lines and their respective easements will have SDR-35 PVC encasement.
2) When crossing a gas line or gas easement the rules and specifications of the gas company who owns the easement will be followed.
3) If an encroachment agreement is needed then the design engineer shall acquire such agreement and furnish a copy to JCSUD.
4) Typical JCSUD encasement standards and procedures will be followed.

5) All gas lines and their respective easements will have SDR-35 PVC encasement laid from easement ROW line to ROW line.

1.1.13 Abandonment of Water Lines

A) When a waterline is to be abandoned, allowances shall be made so that existing and new water mains may be in service simultaneously, thereby providing a means for transferring customers' service from the old main to the new main with minimal interruption.

B) If the construction of a proposed main necessitates the abandoning of the existing main prior to the new main's placement into service, provisions for providing temporary services must be addressed.

C) On mains to be abandoned, the design engineer shall note locations of "cut and plug" as close as possible to the main that remains in service.

D) Unless approved otherwise, all abandoned water mains under pavement and structures shall be plugged.

E) Fire hydrants, valves, and other fittings located on mains to be abandoned shall be removed and delivered to JCSUD.

1.1.14 Relation to Sanitary Sewer Mains and Appurtenances

A) No physical connection shall be made between a drinking water supply and a sanitary sewer system.

B) Appurtenances shall be designed and constructed so as to prevent any possibility of sewage entering the drinking water system.

C) Water mains shall be located a minimum of 9-feet horizontally outside to outside from existing or proposed sanitary sewer mains, manholes, cleanouts and appurtenances.

D) Where the 9 - feet separation distance cannot be achieved, the following criteria shall apply:

a. <u>New water Main Installation – Parallel Lines:</u>

i. Where a new water main parallels an existing, non-pressure or pressure rated sanitary sewer main, and the design engineer is able to determine that the existing sanitary sewer main is not leaking:

1. The new water main shall be located a minimum of 2-feet above and a minimum of 4-feet horizontally between outside diameters from the existing sanitary sewer main.
2. Every effort shall be made not to disturb the bedding and backfill of the existing sanitary sewer main.

ii. Where a new water main parallels an existing pressure rated sanitary sewer main and it cannot be determined by the design engineer if the existing sanitary sewer main is leaking:

1. The existing sanitary sewer main shall be replaced with at least 150-psi pressure rated pipe.
2. The new water main shall be located a minimum of 2-feet above and a minimum of 4-feet horizontally between outside diameters from the replaced sanitary sewer main.

iii. Where a new water main parallels a new sanitary sewer main:

1. The sanitary sewer main shall be constructed of at least 150-psi pressure rated pipe.

2. The new water main shall be located a minimum of 2-feet above and a minimum of four feet horizontally between outside diameters from the existing sanitary sewer main.

b. New Water Main Installation – Crossing Lines:

i. Where a new water main crosses over an existing, non-pressure rated sanitary sewer main:

1. A minimum 2-foot separation distance between outside diameters shall be maintained.
2. One segment of the water main pipe shall be centered over the sanitary sewer main such that the joints of the water main pipe are equidistant and at least nine feet horizontally from the centerline of the sanitary sewer main.
3. Whenever possible, the crossing shall be centered between the joints of the sanitary sewer main pipe.
4. Every effort shall be made not to disturb the bedding and backfill of the existing sanitary sewer main.
5. If the existing sanitary sewer main is disturbed or shows signs of leaking it shall be replaced for at least 9-feet in both directions (18-feet total) with at least 150-psi pressure rated pipe.

ii. Where a new water main crosses over an existing, pressure rated sanitary sewer main:

1. An absolute minimum separation distance of 6-inches between outside diameters shall be maintained.
2. One segment of the water main pipe shall be centered over the sanitary sewer main such that the joints of the water main pipe are equidistant and at least nine feet horizontally from the centerline of the sanitary sewer main.
3. Whenever possible, the crossing shall be centered between the joints of the sanitary sewer main pipe.
4. Every effort shall be made not to disturb the bedding and backfill of the existing sanitary sewer main.
5. If the existing sanitary sewer main is disturbed or shows signs of leaking it shall be replaced for at least 9-feet in both directions (18-feet total) with at least 150-psi pressure rated pipe.

iii. Where a new water main crosses over a new, non-pressure rated sanitary sewer main and the standard length of the sanitary sewer main pipe is at least 18-feet in length:

1. A minimum 2-foot separation distance between outside diameters shall be maintained.
2. The sanitary sewer -main shall be constructed of pipe with a minimum pipe stiffness of 115-psi at 5.0% deflection (SDR 26) for at least 9-feet in both directions (18-feet total) from the centerline of the water main.
3. One segment of the water main pipe shall be centered over the sanitary sewer main such that the joints of the water main pipe are equidistant and at least nine feet horizontally from the centerline of the sanitary sewer main.
4. Whenever possible, the crossing shall be centered between the joints of the sanitary sewer main pipe.
5. The sanitary sewer main shall be embedded in flowable fill from four inches below to 6-inches above the outside diameter of the pipe for the total length of one pipe segment, minimum 9-feet in each direction from water main, plus 12-inches beyond the joint on each end.

iv. Where a new water main crosses over a new, non-pressure rated sanitary sewer main and the standard length of the sanitary sewer main pipe is less than 18-feet in length, one of the following two procedures must be followed:
    1. Procedure A
        1) A minimum 2-foot separation distance between outside diameters shall be maintained.
        2) One segment of the water main pipe shall be centered over the sanitary sewer main such that the joints of the water main pipe are equidistant and at least nine feet horizontally from the centerline of the sanitary sewer main.
        3) The sanitary sewer main within 9-feet horizontally on either side of the water main shall be constructed of pipe having a minimum pressure rating of at least 150-psi.
    2. Procedure B
        1) The sanitary sewer main shall be encased in a section of pipe with a minimum pipe stiffness of 115-psi at 5.0% deflection (SDR 26) for at least 9-feet in both directions (18-feet total) from the centerline of the water main.
        2) An absolute minimum separation distance of 6-inches shall be maintained between outside diameters of the casing pipe and water main pipe.
        3) One segment of the water main pipe shall be centered over the sanitary sewer main such that the joints of the water main pipe are equidistant and at least 9-feet horizontally from the centerline of the sanitary sewer main.
        4) The casing pipe shall be at least two nominal pipe diameters larger than carrier pipe.
        5) The carrier pipe shall be supported at 5-foot or less intervals with casing spacers, with a spacer being located a maximum of 2-feet from each joint.
        6) Each end of the casing pipe shall be sealed with at least 2-feet of watertight non-shrink cement grout or a manufactured watertight seal.

v. Where a new water main crosses over a new, pressure rated sanitary sewer main:
    1. An absolute minimum separation distance of 6-inches between outside diameters shall be maintained.
    2. The sanitary sewer main shall be constructed of at least 150-psi pressure rated pipe.
    3. One segment of the water main pipe shall be centered over the sanitary sewer main such that the joints of the water main pipe are equidistant and at least 9-feet horizontally from the center line of the sanitary sewer main.
    4. Whenever possible, the crossing shall be centered between the joints of the sanitary sewer main pipe.
    5. The sanitary sewer main shall be embedded in flowable fill from four inches below to 6-inches above the outside diameter of the pipe for the total length of one pipe segment, minimum 9-feet in each direction from water main, plus 12-inches beyond the joint on each end.

vi. Where a new water main crosses under a sanitary sewer main:

1. An absolute minimum separation distance of 1-foot between outside diameters shall be maintained.
2. The water main shall be encased in a section of pipe with a minimum pipe stiffness of 115-psi at 5.0% deflection (SDR 26) for at least 9-feet in both directions (18-feet total) from the centerline of the sanitary sewer main.
3. The casing pipe shall be at least two nominal pipe diameters larger than carrier pipe.
4. The carrier pipe shall be supported at 5-foot or less intervals with casing spacers, with a spacer being located a maximum of 2-feet from each joint.
5. Each end of the casing pipe shall be sealed with at least 2-feet of watertight non-shrink cement grout or a manufactured watertight seal.
6. Both the water main and sanitary sewer main must pass a pressure and leakage test as specified in AWWA C600.
7. Alternatively to encasement pipe, the water main can be constructed of ductile iron or steel pipe with mechanical or welded joints as appropriate.

c. Manholes, cleanouts and appurtenances:
   i. Where a new water main crossing within 9-feet of a new or existing sanitary sewer manhole, cleanout or other appurtenance:
      1. The water main shall be encased in an 18-foot or longer section of pipe with a minimum pipe stiffness of 115-psi at 5.0% deflection (SDR 26).
      2. The casing pipe shall be centered on the sanitary sewer manhole, cleanout or appurtenance and shall be at least two nominal pipe diameters larger than the carrier pipe.
      3. The carrier pipe shall be supported at 5-foot or less intervals with casing spacers, with a spacer being located a maximum of 2-feet from each joint.
      4. Each end of the casing pipe shall be sealed with at least 2-feet of watertight non-shrink cement grout or a manufactured watertight seal.

E) For the instances described above, the following conditions shall apply:
   a. Acceptable materials for new pressure rated pipe for non-potable use shall include PVC C-900, minimum SDR 26.
   b. Where an option is given to encase the carrier pipe or use pressure rated pipe, the encasement option shall be used.
   c. No change in the inside diameter of a sanitary sewer main shall be allowed such that would interrupt smooth flow within the pipe.
   d. Flowable fill, also called cement stabilized sand or lean grout, shall consist of at least 2.5 bags of cement per cubic yard of mixture. The use of brown coloring in flowable fill for pressure rated sanitary sewer main embedment is recommended for identification during future construction.
   e. In all cases suitable backfill or other structural protection shall be provided to prevent settling and/or failure of the higher pipe.

F) Location of fire hydrants
   a. Fire hydrants shall not be installed within nine feet vertically or horizontally of any sanitary sewer main, manhole, appurtenance or service line regardless of the type of construction.

G) Location of potable or raw water supply or suction lines
   a. Suction mains to pumping equipment shall not cross sanitary sewer mains or service lines.
   b. Raw water supply lines shall not be installed within 5-feet of any tile or concrete sanitary sewer main or service line.

H) Proximity of septic systems

a. Water mains shall not be installed closer than 10-feet to septic system drain fields or tanks.

I) Water and sewer lines shall be installed in separate trenches.

J) For other instances not covered in these design standards consult current TCEQ Regulations.

1.2 Disinfection

1.2.1 General

A) Each unit of water distribution system shall be disinfected with chlorine before acceptance or domestic operation. The chlorinating material shall conform to the requirements of AWWA B 300-10.

1.2.2 Taps For Disinfection

A) If a water service tap is not installed within 1000-feet of line length, a tap will be installed so that no length of pipe run will be greater than 1000-feet without a tap.

B) Taps at the start of a new subdivision shall be converted into water quality sampling stations.

C) Taps at other disinfection points shall be abandoned if not needed after.

1.2.3 Chlorination

A) The amount and method of chlorination shall be in accordance with current TCEQ requirements and AWWA C651 using the continuous-feed method. In case of conflicting requirements, TCEQ Chapter 290 shall govern.

B) The initial free residual must be equal to or above 25mg/L and after a 24 hour hold time have a free residual equal to or above 10mg/L.

C) A JCSUD representative must be present to perform the residual test.

1.2.4 Testing

A) Bacterial samples will be collected and tested for every 1000-feet of line installation according to TCEQ Chapter 290 Rules.

B) Water quality sampling stations shall be installed at the start of a new subdivision and at the start of subsequent phases of the subdivision.

a. Sampling stations shall be installed at the initial chlorine injection points.

b. Sampling stations shall be designed per **JCSUD Standard Detail VL-202.**

1.3 Pressure Testing

1.3.1 General

A) Unless otherwise specified, hydrostatic pressure tests will be made as directed by the District and under direct supervision.

B) Pressure during the testing of the lines shall be raised to the lowest working pressure at the lowest elevation of the pipe and that pressure will be maintained for a period not less than 4 hours.

C) The test will be managed such that no more than 50-feet elevation difference occurs on the segment tested.

1.3.2 Inspection

A) During the testing period, critical pressure points shall be inspected for leaks. Pressure tests shall be conducted as follows:

1. Fill pipe with water until all air is exhausted.
2. Bring pressure to rated pipe pressure by pumping from a container.
3. Refill container and maintain pressure for 4 hours.
4. Measure water required to refill container to pre-test level.

1.3.3 Leakage Limits

A) No piping installations will be accepted until or unless the leakage is less than 10 gallons per inch of pipe diameter per mile of pipe per 24 hours

1.4 JCSUD Approved Parts

Table 4 – JCSUD Approved Parts

CARRIER PIPE					
DESCRIPTION	**AWWA/ASTM**	**MANUFACTURER**	**MODEL/TYPE**	**SIZE**	**COMMENTS**
PVC	C-900	VARIOUS	235 PSI DR 18	4"-16"	CARRIER PIPE FOR TYPICAL WATER MAINS
DUCTILE I.P.	AWWA C 151	VARIOUS	CLASS 50	4"-30"	
DIAMOND LOK PVC	C-900	DIAMOND PLASTICS	LOK-21/235 PSI (DR-18)	4"-16"	WHEN RESTRAINED PVC JOINTS ARE NEEDED
HDPE POLY PIPE	AST D2737 (CTS)	VARIOUS	SDR-9/250 PSI	1"-2"	FOR SERVCE CROSSINGS
COPPER	ASTM B88	VARIOUS	TYPE K SOFT COPPER	¾"-1"	FOR SERVICES

ENCASEMENT PIPE					
DESCRIPTION	**AWWA/ASTM**	**MANUFACTURER**	**MODEL/TYPE**	**SIZE**	**COMMENTS**
PVC ENCASEMENT FOR SERVICE	ASTM D 1785	VARIOUS	SCHEDULE 40 W/GLUED JOINTS	1.5"	
PVC ENCASEMNET FOR WATER MAINS	ASTM D 3034	VARIOUS	SDR-35/PS46	10"—36"	
STEEL CASING FOR MAIN AND SERVICES		VARIOUS	3/8" THICK / 35,000 PSI	VARIOUS	

CASING SPACES AND END SEALS				
DESCRIPTION	**MANUFACTURER**	**MODEL/TYPE**	**SIZE**	**COMMENTS**
CASING SPACERS	RACI		8"-15"	FOR SEWER CARRIER PIPE ONLY
	BWM	KC-3	3"	FOR 3" SDR-21 Through 6" SDR-35 CASING
	CCI PIPELINE SYSTEMS	CSS12/STAINLESS STEEL	4"-16"	FOR WATER CARRIER PIPE ONLY
END SEALS	RACI	ESPANIT/TYPE C		

CORPORATION STOPS					
DESCRIPTION	**AWWA/ASTM**	**MANUFACTURER**	**MODEL/TYPE**	**SIZE**	**COMMENTS**
CORPORATION FOR LONG SIDE DUAL	AWWA C800/ASTM B584	FORD, MUELLER	FORD: F1000-4-G-NL MUELLER:B-25008N	1"	"CC" THREADS X CTS
CORPORATION FOR LONG SIDE SINGLE					
CORPORATION FOR SHORT SIDE DUAL		FORD	FB1600-4-NL	1"	"CC" THREADS X FIPT
CORPORATION FOR SHORT SIDE SINGLE		FORD, MUELLER	FORD: F100-3-G-NL MUELER: -25008N	¾"	"CC" THREADS X CTS
CORPORATION FOR SHORT SIDE SINGLE		FORD, MUELLER	FORD:F1000-4-G-NL MUELLER: B-25008N	1"	

TEES					
DESCRIPTION	**AWWA/ASTM**	**MANUFACTURER**	**MODEL/TYPE**	**SIZE**	**COMMENTS**
TEE FOR LONG SIDE DUAL	AWWA C800/ASTM B584	FORD	T444-334-G-NL	1"X3/4"X3/4"	CTS OUTLETS
TEE FOR SHORT SIDE DUAL			T448-334-G-NL	1"X3/4X3/4"	MIPT X CTS X CTS

ANGLE STOPS/CUT OFFS					
DESCRIPTION	**AWWA/ASTM**	**MANUFACTURER**	**MODEL/TYPE**	**SIZE**	**COMMENTS**
STANDARD ANGLE STOP	AWWA C800/ASTM B584	FORD	BA43-232-WR-G-NL	5/8" X 3/4" X 3/4"	MUST INCLUDE WINGLOCK AND 360 DEGREE TEE-HEAD ROTATION
			BA43-444-WR-G-NL	1"	MUST INCLUDE WINGLOCK AND 360 DEGREE TEE-HEAD ROTATION
IN-LINE BALL VALVE CURB STOP			B11-777-WR-NL	2"	CUSTOMER CUT-OFF FOR 2" METER ASSEMBLIES

BRASS COUPLINGS					
DESCRIPTION	**AWWA/ASTM**	**MANUFACTURER**	**MODEL/TYPE**	**SIZE**	**COMMENTS**
COUPLING	AWWA C800/ASTM B 584	FORD	C44-33-G-NL	¾" X 3/4"	CTS X CTS
			C44-34-G-NL	¾" X 1"	CTS X CTS
			C44-44-G-NL	1" X 1"	CTS X CTS

METER BOXES				
DESCRIPTION	MANUFACTURER	MODEL/TYPE	SIZE	COMMENTS
STANDARD PLASTIC BOX, OVERLAPPING METER LID W/ CAST IRON READER FLAP	NDS	NDS D1200-OLCIR	14"X19"X12"	FOR 5/8" & ¾" METERS
DUAL PIPE SLOT JUMBO BOX WITH CAST IRON READER FLAP		D1500-DUDICIR	13"X20"X12"	FOR 1" METERS
LARGER METER BOX W/ BOLT DOWN LID AND CAST IRON READER FLAP		126BCDMFCIB	17"X30"18"	FOR 2" METERS

TRACER WIRE/TRACER BOX				
DESCRIPTION	MANUFACTURER	MODEL/TYPE	SIZE	COMMENTS
TRACER WIRE	VARIOUS		#12 AWG	SOLID COPPER WIRE WITH BLUE COATING
TRACER WIRE BOX	COPPERHEAD	CD14*TP/BLUE	14"	

GATE VALVES					
DESCRIPTION	AWWA/ASTM	MANUFACTURER	MODEL/TYPE	SIZE	COMMENTS
RESILIENT WEDGE	AWWA C509, C515	M&H	SYLE 4067	4"-20"	SQUARE NUT, COUNTER-CLOCKWISE OPEN
		CLOW	F6100,F6102,F5106		
		MUELLER	A-2360		
		AMERICAN FLOW CONTROL	SERIES 2500		
VALVE STEM EXTENSION		TEXAS WATER PRODUCTS		24"-72"	SIZE OF THE EXTENSION MAY VARY BASED ON THE GRADE

DUCTILE IRON FITTINGS				
DESCRIPTION	AWWA/ASTM	MANUFACTURER	SIZE	COMMENTS
DUCTILE IRON FITTINGS CEMENT MORTAR LINING	AWWA C153, CEMENT MORTAR LINING AWWA C104	VARIOUS	3"-30"	BITUMINOUS EXTERIOR COATING

RESTRAINT GLANDS					
DESCRIPTION	AWWA/ASTM	MANUFACTURER	MODEL/TYPE	SIZE	COMMENTS

PVC JOINT RESTRAINT	AWWA C111/ASTM F1674	STAR PIPE	STARGRIP SERIES 4000	3"-30"	
		EBAS	MEGALUG SERIES 2000PV		

FIRE HYDRANTS				
DESCRIPTION	**AWWA/ASTM**	**MANUFACTURER**	**MODEL/TYPE**	**COMMENTS**
FIRE HYDRANTS	AWWA C502	MUELLER	SUPER CENTURION 250	MUST BE PAINTED RED AT THE FACTORY. IF IN AN AREA WITH NO AVAILABLE FIRE FLOW THE HYDRANT MUST BE BLACK
		CLOW	MEDALLION	
		AMERICAN DARLING	HB-84-B	
		M&H	STYLE 129	

TAP SADDLES/SLEEVES					
DESCRIPTION	**AWWA/ASTM**	**MANUFACTURER**	**MODEL/TYPE**	**SIZE**	**COMMENTS**
STAINLESS STEEL DOUBLE BAND TAP SADDLE	AWWA C800	SMITH-BLAIR	STYLE 317	1" - 2"	1" - "CC" THREADS, 2" – IRON PIPE THREADS
STAINLESS STEEL DOUBLE BAND TAP SLEEVE	AWWA C223		STYLE 663	4" OR LARGER	COATED STAINLESS STEEL AND FLANGED OUTLET

AUTOMATIC FLUSHING STATIONS					
DESCRIPTION	**AWWA/ASTM**	**MANUFACTURER**	**MODEL/TYPE**	**SIZE**	**COMMENTS**
Z9400-BLUETOOTH	AWWA C651-14	KUPERFERLE	ECLIPSE #9400A	2"	MUST INCLUDE BLUETOOTH CONTROLLER
Z9400-A-BLUETOOTH				1"	

VAULTS					
DESCRIPTION	AWWA/ASTM	MANUFACTURER	MODEL/TYPE	SIZE	COMMENTS
Double Check Backflow Preventer	ASTM A615	Park	DDBP	3",4",6",8",10", and 12"	

Section 2 - Wastewater Design Standards

2.1 General Design Criteria

2.1.1 Rules and Regulations

A) All wastewater design shall conform to 30 TAC §217: Design Criteria for Domestic Wastewater System. These rules do not supersede or replace any other state statutes or local or federal requirements such as EPA requirements or the Occupational Safety and Health Administration (OSHA) requirements.

2.1.2 Wastewater Main Size Classification

A) Wastewater collection mains are classified as those that have a pipe diameter of 6 inches or greater.
B) Wastewater collection lines that have a diameter of 4 inches are considered to be service lines.
C) Line sizes and their respective guidelines described herein are for 4-15 inch diameter pipes.

Table 5 – Pipe Diameter

Category	Pipe Diameter (inches)
Service	4
Collection	6 or Greater

2.1.3 Minimum Pipe Sizes

A) The minimum pipe diameter for any gravity collection main shall be 8-inches, unless otherwise stated and approved by JCSUD on the plans.
B) The minimum size of residential use service lines shall be 4-inches.
C) All commercial use service lines shall be 6-inch or greater, depending upon projected usage.

Table 6 – Minimum Pipe Diameter

Category	Minimum Pipe Diameter (inches)
Residential Service	4
Commercial Service	6 or Greater
Collection Main	8

2.1.4 Depth of Cover

A) The depth of cover is measured from the top of the pipe to the natural or finished ground surface grade.
B) Sewer mains shall have a minimum cover of 4-feet.
C) Service lateral lines shall have a minimum cover of 3-feet and a maximum of 5-feet.

2.1.5 Bores and Road Crossing

A) All bores will follow the guidelines set forth by the entity that governs the roadway i.e. TXDOT, Johnson County Public Works, or City. Bores and encasement shall follow requirements outlined in JCSUD Specifications.

2.1.6 Pipe Material

A) All sewer pipes are to be SDR 35 PVC (ASTM D 3034), unless the following applies:

1) The depth of cover from final grade to the top of the pipe is 10-feet or greater. In such cases SDR 26 PVC (ASTM D 3034) will be used.
2) When there is a potable water line that cannot maintain a 9-foot separation then SDR 26 PVC (ASTM D2241) will be used and the guidelines in subchapter 2.1.9 will be followed.

2.1.7 Minimum and Maximum Slope

A) All wastewater collection mains must contain slope sufficient to allow a velocity when flowing full not less than 2ft/sec and no greater than 10 ft/sec. All wastewater laterals shall have a minimum slope of 2% and a maximum of 5%. The slopes shown in **Table 7** adhere to the rules set forth in 30 TAC §217.53 and NCTCOG standards.

Table 7 - Slopes

Size of Pipe (inches)	Minimum Slope (%)	Maximum Slope (%)
4	2	5
6	.50	12.35
8	.33	8.4
10	.25	6.23
12	.20	4.88
15	.15	3.62

2.1.8 Excavation and Embedment

A) The trench should be straight with a minimum trench width as specified in **Table 8**
B) The embedment and backfill shall conform to the "NCTCOG Class H Embedment" (See Standard Detail TR-100), using ¾" washed rock to a depth of 6 inches on all sides of the pipe.
C) When there is a crossing or parallel run of sewer service pipe within 9-feet of a potable water line, the rules and procedures in the following subchapter 2.1.9 will dictate how the embedment shall be.
D) Native material from the trench excavation may be used after the specified embedment with no rocks larger than 3 inches in diameter or clay lumps larger than 6 inches in diameter allowed.

Table 8 – Trench Width

Pipe Diameter (inches)	Minimum Trench Width (inches)
4	18
6	20
8	24
10	28
12	30
15	33

2.1.9 Separation from Potable Water Lines

A) In accordance with 30 TAC §217.53, wherever possible, collection system pipes and manholes must be located below a water supply pipe and be located at least 9-feet from all water supply pipes. If these specifications cannot be met, then the procedures listed below will be followed.
    1) Parallel pipe where the collection system pipe is above the water supply pipe and comes within 9-feet
        i) If a collection system pipe is located above a water supply pipe and runs parallel to the water supply pipe or if the pipe is above and is within 9-feet, each portion of the collection

system pipe within 9-feet of the water supply pipe must be encased. The casing pipe must be SDR 26 PVC (ASTM D2241).

ii) Encases the entire length of collection system pipe that is within 9-feet of the water supply pipe;

iii) Is sealed at both ends with cement grout or a manufactured seal;

iv) Is at least two nominal sizes larger than the wastewater collection pipe; and

v) Is supported by spacers between the collection system pipe and the encasing pipe at a maximum of five-foot intervals.

2) Wastewater pipe located below and running parallel to a water supply pipe

i) If a collection system pipe is located below a water supply pipe and runs parallel to the water supply pipe, each portion of the collection system pipe within 9-feet of the water supply pipe must either be SDR 26 PVC (ASTM D2241) according to subparagraph (ii) of this paragraph or must be encased in a casing pipe according to subparagraph (iii) of this paragraph.

ii) A collection system pipe that runs parallel to and below a water supply pipe must be SDR 26 PVC (ASTM D2241), corrosion-resistant, non-brittle pipe that:

a) is located at least two vertical feet below the water supply pipe;

b) is located at least four horizontal feet away from the water supply pipe; and

c) Includes joints that are designed to seal at atmospheric pressure.

iii) A casing pipe for a collection system pipe that runs parallel below a water supply pipe must be SDR 26 PVC (ASTM D2241) that:

a) Is sealed at both ends with cement grout or a manufactured seal;

b) Is at least two nominal sizes larger than the wastewater collection pipe; and

c) Is supported by spacers between the collection system pipe and the encasing pipe at a maximum of five-foot intervals.

3) Crossing wastewater pipes within nine feet, where the collection system pipe is below the water supply pipe.

i) If a collection system pipe crosses below a water supply pipe, each portion of the collection system pipe within nine feet of the water supply pipe must either be SDR 26 PVC (ASTM D2241) pipe according to subparagraph (ii) of this paragraph, or must be encased in cement-stabilized sand according to subparagraph (iii) of this paragraph, or must be encased in a casing pipe according to subparagraph (iv) of this paragraph.

ii) A collection system that crosses below a water supply pipe and is constructed with SDR 26 PVC (ASTM D2241), corrosion-resistant, non-brittle pipe must:

a) have at least 6-inches of separation between the outsides of the pipes;

b) Be centered on the crossing;

c) Be at least 18 feet long; and

d) Terminate at joints that are designed to seal at atmospheric pressure.

iii) A collection system pipe that crosses below a water supply pipe and is constructed of any material other than at least 150-psi pressure class, corrosion- resistant, non-brittle pipe must:

a) Have at least two feet of separation between the outsides of the pipes; a

b) Be encased in cement-stabilized sand backfill that meets the requirements of subparagraph (D) of this paragraph.

iv) A casing pipe for a collection system pipe that crosses below a water supply pipe must be SDR 26 PVC (ASTM D2241) pipe that is:

a) sealed at both ends with cement grout or a manufactured seal;

b) At least two nominal sizes larger than the wastewater collection pipe; and

c) Supported by spacers between the collection system pipe and the encasing pipe at a maximum of five-foot intervals.

v) Cement-stabilized sand for encasing collection system pipes must:
   a) See Standard Detail Drawing TR-101
   b) include at least 160 pounds of cement for every cubic yard of sand;
   c) Be installed beginning one-quarter pipe diameter below the centerline of the collection system pipe;
   d) Be installed ending one full pipe diameter above the top of the collection system pipe, or 12-inches above the top of the collection system pipe, whichever is greater.

vi) Crossing wastewater pipes within nine feet, where the collection system pipe is above a water supply pipe
   a) If a collection system pipe crosses above a water supply pipe, each portion of the collection system pipe within nine feet of the water supply pipe must either be encased in a casing pipe according to subparagraph (b) of this paragraph or must be constructed using at least 150-psi pressure class pipe according to subparagraph (c) of this paragraph.
   b) A casing pipe for a collection system pipe that crosses above a water supply pipe must be constructed of at least 150-psi pressure class pipe that is:
      I) Sealed at both ends with cement grout or a manufactured seal;
      II) At least two nominal sizes larger than the wastewater collection pipe; at a maximum of five-foot intervals.
   c) A collection system pipe that crosses above a water supply pipe must be constructed of at least 150-psi pressure class, corrosion-resistant, non-brittle pipe and must use a manufacturer approved adapters. Gasketed joints, compression joints, and other non-bonded joints must be designed to seal at atmospheric pressure.

vii) Manholes within nine feet of a water supply pipe
   a) If a nine-foot separation distance between a manhole and a water supply pipe cannot be achieved, the manhole must either:
      I) Have no measurable leakage during a leakage test conducted according to the requirements in 30 TAC §217.58 (relating to Testing Requirements for Manholes); or
      II) Have all portions of the manhole within nine feet of a water supply pipe encased in at least one foot of cement stabilized sand that meets the requirements of 2.1.9 Paragraph "3.v".

2.1.10 Manhole Design

A) Location
   1) Manholes shall be placed at:
      i) all points of changes in pipe alignments, grade, and size
      ii) at any intersection of all pipes
      iii) At the end of all pipes, no end of the line cleanout is permitted. A manhole placed at the end of a wastewater collection system pipe that may be extended in the future must have a full joint of pipe stubbed out for future use with a cap or plug that ensures a watertight seal
      iv) Any location where a 6-inches or greater service line is being connected to a main

B) Spacing
   1) Manholes may not be spaced further apart than the distance specified in the following table from 30 TAC §217.55(g):

Table 9 – Manhole Spacing

Pipe Diameter (in)	Max. Manhole Spacing (ft)
6-15	500
18-30	800

C) General Manhole Design and Specifications
   i) All manholes will meet all requirements specified in 30 TAC §217.55. Manholes shall be pour in place concrete or precast concrete. The approved specifications for pour in place and precast manholes are shown on Standard Detail Drawings MH-100 and MH-101, respectively.
   ii) All drop manholes, however, shall have an inside diameter of 60". The foundation of the manhole shall be 3/4" washed rock at a depth of no less than 12". All other foundations specifications will follow NCTCOG Standards.

1) Drop connections shall be used when the flowline of the influent pipe is 24" higher than the flowline of the effluent pipe. An outside drop will be used when the influent pipe is 8" in diameter or larger. For an outside drop, the Standard Detail Drawing MH-203 will be used. For connections 6" in diameter or smaller the Standard Detail MH-202, for an inside drop connection, will be used.
2) When there is an invert intersection at the bottom of the manhole the Standard Detail Drawing MH-201 will be used to ensure continuity of flow.
3) All manholes will have an inflow protector or "rain pan" installed underneath the manhole lid.

D) Liners and coatings
1) All manholes will have an approved exterior coating applied and on a case by case basis may also be required to have an approved interior lining to prevent corrosion, degradation and infiltration. All coatings and linings applied will follow the specific product application instructions from the manufacturer. The list of approved coatings/linings are listed below:
   i) Exterior Coating
      a) Sherwin Williams HI-MIL SHER-TAR® EPOXY B69B40 (recommended thickness: 20 mils)
      b) Tnemec® Hi-Build Tnemec-Tar series 46H-413 (Recommended thickness: 16-20 mils)
      c) Blackhawk Liquid Asphalt Coating BH5011(recommended coverage:1 gallon per 300sqft)
   ii) Interior Lining
      a) Sherwin Williams DURA-PLATE® 6100 High Performance Epoxy (recommended thickness: 100-125 mils)
      b) Tnemec® Perma-Glaze Series 435 (recommended thickness: (40-80mils)
      c) ErgonArmor SG2500 Series Epoxy (recommended thickness: 80-125 mils)

2.2 Wastewater Lateral Service

2.2.1 Lateral Taps and Tees at the Main

A) All lateral 4" taps with saddle-type connectors on gravity mains shall be made at either 10 o'clock or 2 o'clock.
B) If using a Tee wye to connect the lateral to the main the tee must also be oriented in the same manner.
C) No lateral will be permitted to connect horizontally to a sewer main.
D) Where a 6" or greater service line connects to a gravity sewer main, a manhole must be installed.

2.2.2 Lateral Design

A) For all laterals laid the minimum slope allowed will be 2% and the maximum will be 5%.
B) All laterals will be required to have a cleanout installed on the street side of the property line.
C) All cleanouts will have a tee wye cleanout that is sweeping towards the main. (See Standard Detail SV-100).

2.2.3 Property Line Cleanout

A) The horizontal stub out from the cleanout towards the home shall be capped in such a manner as to ensure a water-tight seal to prevent the entry of any foreign matter.
B) The vertical stub out from the cleanout shall be left 3-feet above the current grade and be capped in the same manner as to insure a water-tight seal.
C) The approved cleanout cover that shall be used is a 2 bolt lateral cleanout. Before the final inspec,tion the cleanout cover shall be flush with the finish grade. There shall be an "S" etched into the concrete curb that indicates the location of the service line.

2.3 Inspection and Testing

2.3.1 General

A) All materials and workmanship and all equipment required shall be subject to testing and inspection.
B) No work is permitted to take place without a JCSUD appointed inspector.
C) All testing will follow the rules set forth in 30 TAC §217.57(testing requirements for gravity collection pipes) and in §217.58(testing requirements for manholes).

2.3.2 Required Testing for Gravity Collection Pipes

A) For a collection system pipe that will transport wastewater by gravity flow, the design must specify an infiltration and exfiltration test or a low-pressure air test.
B) The test listed below must conform to the following requirements:

1) Low-Pressure Air Test
   i) A low-pressure air test must follow the procedures described in American Society for Testing and Materials (ASTM F 1417). The testing times listed are in Table 10. from Figure: 30 TAC §217.57(a)(1)(C).

Table 10 – Low-Pressure Air Test

Pipe Diameter (inches)	Minimum Time (seconds)	Maximum Length for Maximum Time (feet)	Time for Longer (seconds/foot)
4	226	597	.380
6	340	398	.855
8	454	298	1.520
10	567	239	2.374
12	680	199	3.419
15	850	159	5.342

   ii) For sections of collection system pipe with an average inside diameter less than 36-inches, the following procedure applies.

a) A pipe must be pressurized to 3.5 pounds per square inch (psi) gauge. If groundwater is present, then a pipe must be pressurized to 3.5-psi gauge greater than the pressure exerted by groundwater above the pipe.
b) Once the pressure is stabilized, the minimum time allowable for the pressure to drop from 3.5-psi gauge to 2.5-psi gauge is computed from the following equation:

$$T = \frac{(0.085\ x\ D\ x\ K}{Q}$$

Where:
T = time for pressure to drop 1.0 pound per square inch gauge in seconds
K = 0.000419×D×L, but not less than 1.0
D = average inside pipe diameter in inches
L = length of pipe line, in feet
Q = rate of loss, 0.0015 cubic feet per minute per square foot internal surface

iii) Since a K value of less than 1.0 may not be used, the minimum testing time for each pipe diameter is shown in the above Table 10.
iv) The JCSUD inspector may stop a test if no pressure loss has occurred during the first 25% of the calculated testing time.
v) If any pressure loss or leakage has occurred during the first 25% of a testing period, then the test must continue for the entire test duration as outlined above or until failure of the test.
a) If a gravity collection system pipe is composed of flexible pipe, deflection testing is also required.
b) For a collection system pipe with an inside diameter less than 27 inches, deflection measurement requires a rigid mandrel.

2) Mandrel Test
i) A rigid mandrel must have an outside diameter not less than 95% of the base inside diameter or average inside diameter of a pipe, as specified in the appropriate standard by the ASTM, American Water Works Association, UNI-BELL, or American National Standards Institute.
ii) If the mandrel diameter is not specified in the standard used in clause (i) of this subparagraph, the mandrel must have an outside diameter equal to 95% of the inside diameter of a pipe. In this case, the inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, must equal the average outside diameter minus two minimum wall thicknesses for outside diameter controlled pipe and the average inside diameter for inside diameter controlled pipe.
iii) All mandrel dimensions must meet the standard used in the following:
a) A mandrel must be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. Adjustable or flexible mandrels are prohibited.
b) A mandrel must have an odd number of runners or legs.
c) A mandrel must have nine or more runners or legs.
d) The length of the mandrel's barrel section must equal at least 75% of the inside diameter of the collection system pipe.
e) Each mandrel size must use a separate proving ring.
iv) Method Options
a) An owner may not use television inspection as a substitute for a deflection test.
b) If requested, the Operations Manager may approve, in writing, the use of a deflectometer or a mandrel with removable legs or runners on a case-by-case basis.
c) A deflection test shall not be conducted until at least 30 days after the final backfill.
d) Collection system pipe deflection must not exceed 5%.

e) If a pipe section fails a deflection test, the contractor shall correct the problem immediately and then must conduct a second test after the final backfill has been in place for at least 30 days.
f) A contractor shall not use any mechanical pulling devices during deflection testing.
g) A contractor shall include a certification in the notice of completion required in §217.14 of this title (relating to Completion Notice), that the collection system passed the deflection tests.

3) Camera Inspection
   i) The Contractor shall furnish all labor, materials, equipment, and incidentals to provide the televising in standard video, recorded in MPEG-1 format and written to DVD video, of sewer main and manholes utilizing a color, closed-circuit television inspection unit to determine their condition.
   ii) The video shall include an inclinometer, visible on the video being viewed, noting the slope of the main being televised.
   iii) After completion of the work specified in the contract documents, and prior to placement of the final course of asphalt or other final surfaces, the newly constructed or rehabilitated sanitary sewer main shall be televised immediately upon cleaning.
   iv) Televising shall be observed by the Inspector or any other JCSUD representative as the camera is run through the system.
   v) Any abnormalities such as, but not limited to, misaligned joints, cracked/defective pipe, and rolled gaskets, shall be repaired by the Contractor solely at his expense.
   vi) Sections requiring repair shall be re-televised to verify the condition of repair.
   vii) No additional compensation shall be provided for all needed repairs, re-cleaning, or re-televising efforts.
   viii) The Contractor shall provide a DVD and log of the televised system for review and approval by the Inspector. If the Contractor provides a DVD of such poor quality that it cannot be properly evaluated, the Contractor shall re-televise as necessary and provide a DVD of good quality at no additional cost to JCSUD. If the Contractor cannot provide a DVD of such good quality that can be reviewed by JCSUD, then JCSUD may elect to televise the line at the Contractor's expense.
   ix) The television unit shall also have the capability of displaying in color, on DVD, pipe inspection observations such as pipe defects, sags, points of root intrusion, offset joints, service connection locations, and any other relevant physical attributes. Each DVD shall be permanently labeled with the following:
      a) Project name
      b) Date of television inspection;
      c) Station-to-station location and size of sanitary sewer
      d) Street/easement location;
      e) Name of Contractor;
      f) Date DVD submitted;
      g) DVD number;
      h) JCSUD Inspector Name.
   x) The Contractor shall provide a written log for each completed segment of DVD sewer main describing the section being televised, flow and camera direction, the position of service connections, description and location of failures, pipe condition, weather conditions, and other significant observations.
   xi) The television inspection equipment shall have an accurate footage counter which displays on the monitor the exact distance of the camera from the center of the starting manhole. A camera with rotating and panning lens capabilities is required. The camera height shall be centered in the conduit being televised. The speed of the camera through the conduit shall not exceed 40 feet per minute.

xii) The Contractor shall be required to have all materials, equipment, and labor force necessary to complete all videotaping on the job site prior to isolating the sewer manhole segment and beginning videotaping operations.

xiii) Proper Television Inspection Procedures

a) Prior to the television inspection the sewer line will be cleaned properly to insure a clear picture of the pipe. Before inspection, there will be water poured into the manhole with the highest flowline elevation. The minimum amount of water needed can be figured using the following formula: ((D^2 x .0408 x L) / 2)

D=nominal diameter of pipe

L=length of pipe being tested

b) There is a zero tolerance for standing water in any size sewer line being inspected.

c) Television inspection shall be done one section between two manholes at a time.

d) The Contractor shall not be allowed to float the camera. If the length of sewer main cannot be televised because of obstructions, the Contractor shall clean the system as is necessary. If, in the opinion of the Inspector, the obstruction is attributed to a collapsed main or pipe deflection, televising shall be suspended, and the remaining televising of the sewer line shall be continued upon successful correction of the blockage by the Contractor at his expense. No additional payment shall be made for additional setups required due to obstructions encountered during televising. No lateral connections shall be made to the sanitary sewer main at the "12 o'clock" position. All lateral connections shall clearly indicate which side of the sanitary sewer main it was installed from.

e) The Contractor is solely responsible for any damage of sewer mains as a direct result of televising operations. Any repair shall also be the responsibility of the Contractor. The method(s) used for securing passage of the camera are at the discretion of the Contractor, and as approved by the Inspector. No sanitary sewer main televising effort shall commence until all pertinent permits or required approvals have been obtained by JCSUD.

f) No separate and/or additional payment will be made for any excavation, man entry, or any other method which may be required to retrieve video equipment that may have been hung up, destroyed, and/or lost during the operation

2.3.3 Required Testing for Manholes

A) All tests must conform to following rules and requirements listed below from 30 TAC §217.58.

B) Each manhole shall be tested, after assembly and before backfilling, using a vacuum test.

C) All manholes must pass a leakage test.

D) A manhole must be tested separately and independently from the collection system pipes.

E) Vacuum Testing

1) The contractor must perform vacuum testing according to this paragraph.

2) If a manhole fails the vacuum test, the contractor must apply grout to the exterior of the excavated manhole before retesting the manhole. A vacuum test must be performed before being backfilled.

F) Texas Test

1) To perform a vacuum test, the contractor shall plug all lift holes and exterior joints with a non-shrink grout and plug all pipes entering a manhole.

2) Grout may not be placed in horizontal joints before testing.

3) Stub-outs, manhole boots, and pipe plugs must be secured to prevent movement while a vacuum is drawn.

4) The contractor shall use a minimum 60-inch/lb torque wrench to tighten the external clamps that secure a test cover to the top of a manhole.

5) A test head must be placed at the inside of the top of a cone section, and the seal must be inflated in accordance with the manufacturer's recommendations.

6) There must be a vacuum of 10-inches of mercury inside a manhole to perform a valid test.
7) A test does not begin until after the vacuum pump is off.
8) Once the vacuum is stable at 10-inches of mercury the time for the vacuum to drop to 9 inches of mercury shall not be less than the time indicated in Table 11.

Table 11 – Vacuum Drop Minimum Time

	Manhole Diameter		
Depth of MH (feet)	48"	60"	72"
	Minimum Time Required (min:sec)		
0-20	0:40	0:50	1:00
22	0:44	0:55	1:06
24	0:48	1:00	1:12
26	0:52	1:05	1:18
28	0:56	1:10	1:24
30	1:00	1:15	1:30

G) American Society for Testing and Materials (ASTM) Test. The owner may require manhole testing that meets the requirements of ASTM C 1244

2.4 Lift Station Guidelines

2.4.1 General

H) These lift station design guidelines are to be used in conjunction with the latest revision of the Texas Commission on Environmental Quality's (TCEQ) TAC 30 Chapter 217 rules.
I) The guidelines do not duplicate the TCEQ's rules and are intended to augment the requirements found in that chapter.
J) Where conflicts exist, the more stringent requirements will be used. For the purposes of these requirements, the terms "lift station" and "pump station" will be interchangeable.
K) In general, these Guidelines are for Lift Stations utilizing a 4-in force main or greater with capacities of 750 gpm or less.
L) Lift Stations proposing grinder pumps and subsequent smaller diameter force mains will be held to much of the same requirements excluding sizes, which shall be determined at time of design.
M) Requirements for lift stations with capacities greater than 750 gpm shall be determined on a case-by-case basis.

2.4.2 Submittal Requirements

A) All lift station plans, specifications and design reports shall be sealed, signed and dated by a licensed professional engineer registered in the State of Texas.
B) Design reports for lift stations that have multiple operational phases shall include complete design calculations demonstrating the adequacy of the facility for future phases. A detailed description of the requirements for future expansions shall be included.
C) The engineer shall evaluate the potential for odor generation in the station regardless of location and include odor control mitigation in the lift station design.

2.4.3 Site Requirements

A) Ownership
   1) The proposed lift station site shall be located in dedicated JCSUD property. Bearing and distances of the site boundary shall be shown on the plans as well as the recordation information. Under no circumstances will a lift station be allowed to be placed into service without a recorded site,

temporary access easement (if necessary), and a permanent access easement. Include recording information and legal description of all sites, access easements, utility easements, and temporary construction easements affecting the facilities on the drawings.

B) General Site Layout

1) The proposed lift station site shall have a minimum fenced area of 30 feet by 30 feet. However, each site shall be reviewed on a case-by-case basis and the minimum overall site dimensions shall be determined at the time of review. It is not the intent of this JCSUD to maintain any more property than is necessary to operate and its facilities.
2) Site access shall be provided by a minimum 20-foot-wide access easement or PUE from a public right-of-way. Larger widths may be required depending on length of road, drainage and other constraints. As noted above, access requirements will be determined on a site-specific basis.
3) The wet well and valve vault shall be located a minimum of 10 feet from the site fencing to the outer edge of the structure.
4) Provide a paved drive of not less than 12 feet in width to the site. City roadway or County roadway standards shall apply for pavement of the 12-ft access drive. Where applicable, the access drive construction shall match the adjacent roadway or street. At a minimum the access drive shall consist of 6-inches (6") of lime stabilized subgrade, six-inches (6") of flexible base, and a 2-inch (2") overlay of hot mixed asphalt concrete (HMAC).
5) All access roads shall be constructed to ensure that the facilities are accessible during a 25-year storm. At the District's discretion, accessibility during a 100-year storm event may be required.
6) Provide an on-site turn-around as part of the access drive to accommodate a standard 8-ft x 18-ft vehicle. Where possible the turn-around shall be located outside the fence, outside the adjacent R.O.W, and within the dedicated access easement.

C) Fencing

1) Enclose all sites with an intruder resistant fence in either of the following configurations:
   i) minimum 6 feet high fence topped with three strands of outward slanting barbed wire
   ii) minimum 8 feet high fence with a single strand of barbed wire.
2) Fences, including barbed wire if used, shall be located completely inside the site boundary.
3) Fencing may be of any of the following materials:
   i) Chain link fencing with galvanized finish or vinyl coating.
   ii) In cases where decorative fencing is used in the surrounding area JCSUD may approve other material such as masonry or concrete.
4) Screening may be required for chain link fencing on a case-by-case basis as determined by the District. This may consist of chain link as described above with wood or plastic slats interwoven into the fence fabric. Landscape screening may be considered on a case-by-case basis if a homeowners association or other entity commits to maintaining it and the landscaping does not interfere with access or site security.
5) Gates shall be a minimum of 16-feet wide overall and may be split into two openings swinging outward. The gates shall have a down post and receptacle in the driveway as well as provisions for padlocking with a chain. If barbed wire is used on the fencing, barbed wire will be provided on the gate(s) as well. In lieu of swinging openings a single, sliding opening may be considered.

D) Grading and Drainage

1) Use drainage swales, driveways, culverts, storm sewers or a combination thereof for access and internal site drainage.
2) Site drainage may sheet flow to a public right-of-way if allowed by the City and County. Storm sewers and culverts shall be sized in accordance with applicable design guidelines.

E) Subsurface Exploration and Geotechnical Study

1) A minimum of one (1) subsurface exploration boring shall be drilled at the location of the proposed lift station. The depth of the boring shall be at least 10 feet below the planned base elevation of the lift station. A competent geotechnical engineer shall review the samples and field test information determined from the boring and shall assign appropriate geotechnical laboratory testing on select soils recovered from the boring. The geotechnical engineer shall interpret the field and laboratory test information and provide recommendations for the design and construction of the lift station in a written engineering report.

2) The purpose of the geotechnical study is to provide information for the design and construction of the lift station prior to commencement of construction operations. The information provided in the geotechnical study should include the following items at a minimum:
   i) A description of the subsurface stratigraphy, including anticipated groundwater elevations at the lift station location.
   ii) Recommended allowable bearing pressures for the base of the lift station and whether an alternate founding depth is recommended due to potentially problematic subsurface conditions at the originally planned founding depth.
   iii) A prediction of the magnitudes of settlement of the lift station at the planned founding elevation.
   iv) A recommendation of the distribution and magnitude of lateral earth pressures that should be considered in the design of the lift station walls.
   v) A description of subsurface conditions that could impact construction of the lift station, such as the presence of rock, a high ground water table, or the presence of wet, caving soils in significant thicknesses, etc.
   vi) A recommended minimum groundwater elevation that should be used in the buoyancy calculations for the lift station.

F) Onsite Manhole

1) Include an on-site manhole no farther than 80-feet from the lift station site. Ideally the on-site manhole shall be located within the fenced area. However, the manhole shall be located so as not to block vehicle access to the facilities and shall be situated in a location that does not receive vehicle traffic.

G) Water Service

1) The design of the lift station shall include a ¾" potable water connection, provide a water meter, meter box, reduced pressure principal backflow assembly (RPBA) conforming to the requirements of AWWA Standard C511-97 or Manual M14, hose bib (self-draining and freeze resistant, installed 12 inches above the 100-year flood plain), hose bib vacuum breaker, and freeze protection.

2.3.4 Wet Well Design

A) Location

1) Flood Protection. The top of the lift station shall be located a minimum of 3-feet above the 100-year flood plain. Where fill is required to raise the lift station to this height or in any other instance requiring site fill, provide transition grades with slope no steeper than 4:1.
2) The top slab elevation of lift stations (including valve vaults) shall be set six (6) inches above the finished grade. Locate the wet well and more specifically the pumps in the wet well on the site such that the crane truck can back up to (or beside) the hatch to facilitate removal of each pump without leaving the pavement. Provide sufficient room for construction access as well as on-going maintenance.

B) Design

1) All lift station wet wells shall be preceded by an on-site manhole inside the fenced area. The manhole shall have a pre-cast flat top to facilitate removal and installation of by-pass pumps. The line connecting this manhole and the wet well shall be designed one pipe diameter larger than required by the District's gravity sanitary sewer criteria so that additional collection lines can be connected in the future. The inside of this manhole shall be coated in accordance with the section on Corrosion Protection and Odor Control.
2) Size the diameter or width of the wet well, hatches, and hatch spacing to accommodate the selected pumping equipment. Consideration should be given to the dimensions of the ultimate pump in a multi-phased lift station to ensure adequate clearances are provided. Provide a minimum of six-inches (6") of clearance from the inside wet well wall to all flanges to facilitate removal of all bolts. Cast-in-place or pre-cast concrete wet wells may be used. Fiberglass (FRP) wet wells may be considered on a case-by-case basis.
3) The wet well volume shall be based on the minimum cycle time of the largest pump planned for the lift station plus additional depth to prevent motor overheating and vortexing. The cycle time shall not be less than the those listed below:

Table 10 – Cycle Times

Pump Horsepower	Minimum Cycle Times (minutes)
less than 50	6
50 – 100	10
Over 100	15

4) The minimum effective volume of the wet well shall be based on the following formula:

$$V = \frac{Q_P t}{4 * 7.48}$$

Where:

V = Volume (ft^3)
Qp = Capacity of largest ultimate pump (GPM)
t = Cycle Time (minutes)
7.48 = conversion factor in gallons/cubic foot

5) The pump capacity "Qp" is the largest pump in alternation. This capacity is to be the actual flow rate of one pump pumping alone against a system head generated with new pipe friction factors (C=150 for PVC and C=140 for DIP).
6) The "OFF" elevation of the wet weather pumps shall be deep enough to prevent vortexing and motor overheating based on the manufacturer's recommendations. At a minimum provide 12 inches between "ALL PUMPS OFF" and the finished floor. The design engineer shall verify that each pump is capable of operating continuously at the "OFF" elevation shown on the plans.
7) The "Lead Pump On" elevation shall be below the flowline of the influent pipe. Subsequent pump "On" elevations shall be sufficiently separated to ensure an adequate cycle time for the lag pumps. Unless a microprocessor based alternator is used which uses first-on-first-off sequencing, the effective volume for each pump shall be used to calculate a finished floor elevation which allows all of the "Pump On" elevations to be below the influent flow line.
8) Size the wet well for a minimum of 6-inches (6") between float settings.

C) Wet Well Slopes

1) Slope the wet well floor a minimum of 15 percent to the pump intakes with a smooth finish. Do not allow grout above the "All Pumps Off" elevation where it will occupy part of the effective volume.

D) Venting

1) The wet well shall have a vent sized such that the maximum velocity of air through the vent is 600 fpm at the firm pumping capacity. Vents shall have a stainless steel insect screen that is easily replaceable and will prevent the entrance of rain water. Vent pipes shall be constructed of 304 stainless steel. If mechanical ventilation is used, all materials shall be corrosion resistant and explosion proof. 30 air changes per hour should be used for the wet well, and 15 for the valve vault. All vents shall terminate a minimum 36 inches above the 100-year flood plain elevation.

E) Dry Well/Valve Vault Clearances

1) All walls shall be a minimum of 18-inches from the outermost edge of all flanges to enable removal of all bolts. Pipes shall have a minimum spacing greater than that required by the pump manufacturer for minimum pump spacing. Swing check valves shall be positioned such that the shafts may be removed without removing the valve body. If concrete pipe supports are provided, ensure that bolt removal is possible. Size hatches to provide unobstructed access to all valves for maintenance and removal.

F) Structural Considerations

1) Follow the latest version of ACI 350 with the exception that the minimum concrete cover over steel reinforcing shall be four (4) inches where contact with raw sanitary sewer is possible.
2) Wet wells are to be designed to resist the effects of buoyancy assuming full saturation of the surrounding soils to the finished grade or the 100-yearflood plain, which ever is greater. Surface friction shall not be included in the design unless a friction factor is provided in a geotechnical report, signed and sealed by a licensed professional geotechnical engineer. A safety factor of 1.1 shall be used for buoyancy resistance.
3) Provide buoyancy calculations at the time of review.
4) Wet well walls shall be designed to withstand lateral earth pressures and static water levels at finished grade as outlined in ACI 350. 3,500 psi concrete shall be used at a minimum. Under no circumstances will ASTM C478 pre-cast sections be allowed.
5) Top slabs shall be designed for a uniform loading of 300 pounds per square foot. Hinged safety grates shall be provided under the hatch and shall not interfere with the pump removal. Clear space openings shall be six (6) inches larger than the largest pump to be installed/ removed in the wet well.
6) Where individual hatches are incorporated into the top slab, the separation distance from inside face to inside face shall be a minimum of 12-inches to facilitate the placement of the concrete and to allow adequate cover over the rebar.
7) If open cut construction is used the excavation shall be backfilled with cement stabilized sand per JCSUD's standard specifications. If caisson (or drilled) construction is used the exterior annular space shall be pressure grouted.

2.3.5 Valving and Piping

1) Valves shall be located in an underground concrete vault. The valve vault shall be structurally connected to the wet well. Equip the valve vault with a stainless steel gooseneck vent or a mechanical ventilation (see Wet well venting requirements), and a gas tight p-trap drain connected to the wet well. The vault shall be constructed as shallow as practical to allow easy

access while providing sufficient room for maintenance and removal of all valves. Provide a pad-lockable aluminum or stainless steel access hatch on the valve vault (structural considerations for wet wells apply to valve vaults). See clearance requirements under section on wet well design.

2) Set the top slab elevation of the valve vault at 6-inches above finished grade.
3) Isolation and check valves shall not be located in the wet well.
4) All bolts, studs and nuts shall be 316 stainless steel. End connections of valves shall be flanged and drilled to ANSI class 125 unless otherwise specified. Provide handwheel operators for valves 4-inches or larger.

B) Resilient Seat Gate Valves

1) Provide valves with a rising stem, resilient seat gate valves with a full round port free from pockets. The resilient gate shall provide bubble tight shut-off with threaded operating stems of brass or stainless steel. Buried valves shall have spur or bevel gearing, valve boxes and stem extensions. Valves shall be ANSI\AWWA C515 compliant, and rated for 250 psig. Valves shall meet or exceed AWWA C509.

C) Air and Vacuum Release Valves.

1) Provide sewage air and vacuum release valves meeting AWWA C512-92 at all high points in the system. The valve's inlet and outlet shall be sized for the anticipated flow rates experienced during filling and draining. Provide a shut-off valve for each release valve. Accessories will include a one-inch (1") blow-off valve and a flexible back flushing hose with a quick disconnect coupling and a ½-inch (½") shut-off valve. The air and vacuum valves shall be manufactured by Apco or Val-Matic.

D) Lever & Weight Check Valves

1) Provide AWWA C508 compliant flanged, cast iron body swing check valves with exterior lever and weight. All three-inch (3") and larger valves shall have Class 125 Flanges. All check valves shall be followed by an isolation valve. TAC §217.62(b)(1)(A) & (B) require swing check valves with an external lever

E) Eccentric Plug Valves

1) Valves shall be non-lubricated eccentric plug valves with semi-steel body and semi-steel resilient face to plug. Above ground valves 10 inches and larger shall be worm gear operated. Equip buried valves with extended waterproof gear operators. Provide valves with stainless steel bushings and meeting the requirements of AWWA C500 & C507.

F) Isolation valves

1) Shall be provided on the discharge side of pumps, positioned such that the pump and/or check valve can be isolated for removal. Provide one-inch diameter drains with ball valves between the isolation valve and the check valve to relieve pressure. Surge relief valves, if required, shall be located at the station and piped to discharge back to the wet well.

G) Force mains

1) Shall be a minimum of 4-inches in diameter. Force mains shall be designed to reduce electrical consumption, yet maintain the minimum velocities required by the TCEQ. For force mains of short length the resultant velocities may be higher where static headlosses are predominate. For longer force mains use the largest pipe diameter permissible to reduce frictional losses and surge generation. For pump stations with 3 or more pumps, the force main velocity shall not be less than 2.5 fps with the smallest pump only in operation. Force main velocities in excess of 6 fps will require the engineer to perform an analysis for possible high and low negative surge pressures in the event of sudden pump failure.
2) Force main piping shall conform to the District's guidelines for pressure piping.

3) Provide a riser pipe to the top of the slab with an isolation valve and male cam-lock with cap to facilitate by-pass pumping operations.
4) Provide calculations of wet well storage above the high-level alarm elevation.

2.3.6 Pumps and Motors

A) Lift station pumps and motors
1) Acceptable Manufacturers: Sulzer, Tsurumi, or JCSUD approved pumps.
2) Stations will be designed for submersible pumps mounted in the wet well. Lift stations shall be designed to discharge the peak design flow (firm capacity) at the calculated system head for initial, interim, and ultimate design phases. Where multiple phases are planned, provide calculations and graphs for all phases in the design report.
3) Firm pumping capacity is defined as the maximum pumping capacity with the largest pumping unit out of service, system losses based on aged piping, and a water level in the wet well at the maximum "Lag Pump On" elevation. Please note that the wet well volumes are based on flow rates greater than the firm capacity.
4) Select pumps with capacity curves that intersect the system head at the firm capacity or intermediate capacity for multiple pump lift stations. The system curve will be generated using the Hazen-Williams Formula by calculating the frictional losses for the selected C coefficient value. The C values used for the selected pipe material are presented in **Table 11.**

Table 11 – C Values

	C Coefficient Value	
Pipe Type	New	After 20 years
Ductile Iron (lined)	140	120
Plastic – PVC	150	130

5) Force main velocities shall be included on the graph as a separate Y axis.
6) Pumps shall be of a non-clog design, capable of passing a 2.5-inch diameter or greater incompressible sphere and shall have suction and discharge openings a minimum of 4 inches in diameter.
7) All submersible pumps shall have tandem mechanical seals with rotating and stationary elements made of tungsten. Cable entries shall have sealed terminal blocks or epoxy-potted connections with gasketed stress-relieving connections. Motors shall be air-filled squirrel cage induction design with class H insulation.

B) Pump Operation
1) Efficiencies shall be greater than 60% with a single pump operating into the system.
2) Leak detection sensors shall be provided in the motor housing.
3) Motor service factor shall be a minimum of 1.15.
4) Electric motors shall be sized so as to operate at maximum design load without use of the service factor.
5) Thermal protection shall be provided in the motor housing.
6) Electric motors (excluding submersible units) shall be equipped with space heaters.

C) Pump Installation
1) Pumps shall be securely supported, per the manufacturer recommendations to prevent movement and vibration during operation. All guiderails shall be vertical and have intermediate supports for section lengths over 10 feet.
2) Provide guiderail-type pump support systems that allow pump removal and installation without requiring dewatering of or entry into the wet well. Rails, lifting chains, and hardware shall be constructed of Series 316 stainless steel.

2.3.7 Corrosion Protection and Odor Control

A) The design of the lift station shall include corrosion resistance for those items located within the wet well, valve vault or within five feet of the top slab. In all lift stations, hydrogen sulfide (H2S) gas generation should be minimized by reducing the turbulence of wastewater discharging into the lift station. It is acknowledged that prediction of H2S concentrations is difficult with varying flow rates as development progresses therefore the following criteria will be used.

B) All lift stations shall use 316 stainless steel for bolts, chains, cables, guide rails, cable brackets, strain relief devices, cable seals, anchor bolts and any riser pipe supports exposed to corrosive gases.

C) All lift stations shall coat the piping in the interior of the wet well with a two coat system of coal tar epoxy with a minimum dry film thickness of 16 mils. Piping in valve vaults not exposed to direct sunlight shall be coated with a three coat system of polyamide epoxy (dry film thickness 10 mils minimum), and piping above ground (or in direct sunlight) shall be coated with a three coat system consisting of two initial coats of epoxy (min 6 mil total) followed by a top coat of polyurethane (2-3 mils). Surface preparations shall follow the SSPC or the NACE recommendations for substrate cleanliness and anchor profile. All coating systems shall be applied in accordance with the manufacturer's recommendations.

D) All lift stations must have an interior wet well coating. Epoxy coating system shall be 100% solids, solvent less, two-component high build epoxy resin system. Materials shall be Raven 405, Strong Seal Epoxy Top Coat and PCS-320 by Polyurea Coating Systems, Inc. or approved equal. Material shall have the following minimum requirements:

Table 12 – Material Requirements

Solids Content (vol%)		100
Compressive Strength, psi	ASTM D579	12,000
Tensile Strength, psi	ASTM D638	7,600
Bond Strength – Concrete	> Tensile Strength of Concrete	

E) All lift station interior coatings shall be applied by the manufacturer's certified applicator.

F) Lift stations greater than 12 feet in diameter or having a cross-sectional area greater than 113 square feet, shall have an air-scrubbing unit that actively removes hydrogen sulfide and organic odors.

2.3.8 Electrical Requirements

1) The wet well and the area extending up to 12" above the wet well shall be classified as Class 1, Division 1, Group D hazardous location per the National Electrical Code (NEC).
2) The panel and all controls shall be covered by a constructed overhang to shield operator from rain.
3) Panel area shall be lit by outside, overhead light fixture.
4) Service racks and switch racks shall be constructed with metal support poles and cross braces. No wooden poles will be allowed.
5) Conduit, bodies, and fittings shall be constructed of aluminum. Aluminum conduit embedded in concrete shall be double-wrapped with vinyl tape or PVC coated.
6) All transformers, control panels, terminal boxes, and other electrical equipment shall be mounted a minimum of 24 inches above the top of slab or finished grade to provide accessibility for maintenance.
7) All equipment shall be permanently labeled to indicate its function or purpose. Labels shall be constructed of material suitable to withstand the environmental conditions in which they operate.

B) Electric Power Requirements
   1) Power sources for serving lift stations will follow the guidelines below:
      i) Where the total motor horsepower does not exceed 10 HP in aggregate and, where any single motor does not exceed 5 HP; 120/240 volt, three-phase service is required.
      ii) Where individual motors do not exceed 5 hp and where three phase service is not available; 120/240 volt, single phase service may be used.
      iii) Motor horsepowers that exceed 10 HP in aggregate or where any single motor is larger than 5 HP shall use 480/277 volt, three-phase service.

C) Emergency Power Requirements
   1) The engineer shall determine reliability per TAC 30 §217.63:
      i) All lift station designs shall incorporate a double throw switch (manual transfer switch) with a generator quick-connect plug. Install the switch in a NEMA 4X stainless steel enclosure and locate it down stream of the main disconnect. Coordinate with JCSUD to determine the type of quick connect plug required.
      ii) At its discretion JCSUD may require that the design incorporate an on-site, automatically starting emergency generator.

D) Electrical Controls
   1) Pump Controller: Solid state, pump alternator, floats, alarm contacts and power supply. The pump alternator shall provide first on, first off (FOFO) operation and mode of operation selector switch to remove a pump from the alternation sequence during maintenance.
   2) Controls and Indicators: Provide the following:
      i) Pump HOA Selector Switch for each pump
      ii) Pump Run Light for each pump
      iii) Pump Seal-Fail Light for each pump
      iv) Pump Over-Temp Light for each pump
      v) Pump Run Elapse Time Meter for each pump
      vi) Seal-Fail and Over-Temp Reset Switch for each pump
      vii) Phase-Fail Light
      viii) Control Power Light On
      ix) High Level Alarm Indicator
      x) Alarm Rotating Beacon Light
      xi) Alarm Horn or Buzzer
      xii) Alarm Reset Switch

E) Motor Protection Devices
   1) Overload relay with the following specifications:
      i) Devicenet communications
      ii) Rate supply Voltage 24 VDC (Supply via devicenet connection)
      iii) Rated insulation voltage 300 VAC
      iv) Rated Operating Voltage 25 VAC
      v) Trip Resistance 3400 Ohms
      vi) User selectable warning and trip settings
         a) Thermal Overload
         b) Phase Loss
         c) Ground Fault
         d) Stall
         e) Jam
         f) Underload
         g) Current Imbalance
      vii) Four NO/NC Digital Inputs

viii) Two NO/NC Digital Outputs

F) Surge Protection Device
   1) Lightning & Surge Protection Device installed on Main Power Bus, single or three phase as applicable. Mount the surge in a separate enclosure and position such that a minimum of bends are required for the leads.

G) Phase Monitoring Relay
   1) Type: Provide a 600-volt, industrial-rated, phase failure relay for motor circuits. Use a shunt-type device which functions independent of line current.
   2) Operation: The relay will monitor line-to-line voltage through three (3) potential sensors. At l0 percent voltage unbalance, or on phase reversal, or a low phase potential, the relay will open the control circuit. Provide a 0.2-second time delay on trip-out to prevent nuisance tripping form transient voltage fluctuations.
   3) Fuses: Provide one (1) fuse per phase ahead of the relay.
   4) Phase Monitoring: For phase monitoring, use Diversified Electronics Cat. No. SLD-440-ALE or approved equal.

H) Level Controls
   1) Primary: Provide PVC ball-type float with mercury switch for each pump "on" elevation, "All Pumps Off" elevation, and High Level Alarm.
   2) Set level control points no less than six (6) inches apart. The "All Pumps Off" setting shall be no closer than 12 inches from the finished floor of the wet well.
   3) Other level controls such as pressure transducers or ultra-sonic transducers may be allowed if approved by JCSUD.

I) Operation
   1) The liquid level in the wet well shall be sensed with float type switches. The floats shall be suspended separately from the roof of the wet well to allow adjustment and maintenance of the individual floats without disturbing the other floats. The floats shall be Teflon coated stainless steel or rubber jacketed polyethylene. The switches shall be direct acting mercury switches operating on 24 VAC.
   2) Pumps are started as the level rises, and when the wet well level is reduced to the "all Pumps Off" elevation, all the pumps are turned off.
   3) The pump alternator, in the controller, alternates the lead/lag pump selection at the end of each pumping cycle.
   4) The high level alarm signal is initiated when the wet well level reaches two (2) feet above the last lag pump "on" elevation. At this elevation any back-up level sensing equipment is energized and used as the primary level control.

J) Alarm Signals
   1) Provide terminal blocks and wiring from dry contacts for the following points from each pump:
      i) Pump HOA Selector Switch for each pump
      ii) Pump Seal-Fail Light for each pump
      iii) Pump Over-Temp Light for each pump
      iv) Control Power
      v) Pump Run indication
      vi) Circuit Breaker Tripped
      vii) Overload Relay tripped
   2) Provide terminal blocks and wiring from dry contacts for the following general station alarm terminals:
      i) High Level Alarm Indicator
      ii) Loss of Power to Station / Main Circuit Breaker tripped.
      iii) Control Panel Door Opened

3) Terminal blocks shall conform to the following requirements:
    i) Size to accommodate wiring size from 16AWG to 22 AWG.
    ii) Rated for 300V AC/DC.
    iii) Maximum voltage on dry contacts not to exceed 4.0 VDC.
    iv) The terminal blocks shall be located no closer than four (4) inches from any edge of the cabinet.
4) The Design Engineer will work with JCSUD personnel to determine best communication method to monitor the lift station. The order of priority is:
    i) Wireless radio communication. Engineer will assist JCSUD in determining radio path to nearest access point and height of tower needed to successfully implement the wireless infrastructure.
    ii) Provide an auto dialer capable of monitoring eight (8) channels and recording real-voice messages. Coordinate with JCSUD to choose the appropriate manufacturer and form of communication (land line, cellular, or other method of communication).
    iii) In the event Item 1 or 2 is selected as the means of communication, provide 30x30-inch (minimum) cabinet in close proximity to the control panel.

K) Enclosures
1) Pump Cable Terminal Boxes
    i) Use terminal boxes of NEMA 4X stainless steel construction, mounted near the pump access hatch for the termination of the pump power and control cables. Use a separate box for the termination of the float cables.
    ii) Terminal boxes shall be mounted on support frames of unistrut, galvanized angle iron, or other approved materials. The use of conduits alone to support terminal boxes shall not be allowed. Terminal boxes shall be mounted no less than 24-inches from the top of slab.
    iii) Terminal boxes shall be readily accessible and shall not interfere with the removal of the pumps or normal operations and maintenance of the wet well. Coordinate with the JCSUD during design.
    iv) Use hub type conduit entries into boxes. Use CSBE seals where cables enter conduits in the wet well to protect the terminal boxes from corrosive gasses.

L) Control Panel Enclosure
1) The control panel shall be NEMA 4X stainless steel with factory stainless steel stands, an inside swing door, back plate, three point latch with pad lock access or quick release latches and pad lock clasp. Mount the control panel no less than 24 inches from the top of slab.
2) Use hub type conduit entries into enclosure.
3) All indicating lights, selector switches, circuit breaker operators, and autodialer shall be accessible and operable with the interior swing door closed. The exterior door shall have only an engraved nameplate with the name of the station and JCSUD's name. No other items are allowed on the face of the panel.
4) Provide two (2) double 120V, ground fault protected single phase receptacles. One shall be mounted outside the control panel in a weatherproof-in-use enclosure and the other shall be located behind the inner panel for the autodialer.

2.3.9 Supervisory Control and Data Acquisition (SCADA)

1) Contractor shall contact TraC-n-trol to coordinate SCADA system setup.
    i) The information required for setup includes:
    ii) Name of the Development and Lift Station Site
    iii) Latitude and Longitude coordinates of the lift station site
    iv) Preliminary plans and specs for the lift station
    v) The manufacturer of lift station pumps and pump control panel
    vi) Timeline for bidding the project

2) Design engineer must include a radio path study report in the lift station engineering report. The radio path study must be done both physically and computer simulated. Both the report and the plans must include the NAD83 State Coordinates of the proposed lift station site. The radio path study report must show a communication solution that will ensure a clear and steady quality radio signal is achieved from the proposed lift station site to one of JCSUD existing facilities with SCADA radio repeater.

3) If a clear and steady quality radio signal cannot be achieved between the proposed lift station and any existing JCSUD facility with SCADA radio repeaters, the design engineer will evaluate existing JCSUD facilities that are not SCADA repeaters near the proposed lift station in order to ensure a clear and steady quality radio signal is achieved as follow: from the proposed lift station to the existing JCSUD non-repeater facility to an existing JCSUD SCADA radio repeater facility. The design engineer must include in the lift station design and the engineering report a section that shows the required upgrades to convert the existing JCSUD non-SCADA radio repeater facility into a SCADA radio repeater.

4) If a steady quality radio signal cannot be achieved through any existing JCSUD facility without SCADA repeater, the design engineer must coordinate with developer to provide a new site for a radio repeater station to achieve a steady quality radio signal from the proposed lift station to any existing JCSUD facility with SCADA radio repeater. Drawings of required repeater standards shall be sent to JCSUD. New radio repeater stations will comply with all access and site requirements for lift station site as described in these guidelines.

5) SCADA system shall monitor for each pump all the following, but not limited to: Pump Hand/Off/Auto Status, Pump Run, Pump Stator Leak, Motor High Temp, Motor Overload, Pump Lost Prime (if self-priming Pumps). In addition, the SCADA system shall monitor all the following, but not limited to: Low Level Alarm, High Level Alarm, Utility Power On, Generator Power On, Transfer Fail, Force Main Continuous Pressure, Wet Well Continuous Level and SCADA Panel Continuous Internal Temperature.

6) SCADA panel must include isolation relays for all digital inputs. Isolation relays must be located within the SCADA panel to separate 120 V ac circuits or others from SCADA 24 V dc.

7) Radio must be located within SCADA panel and be capable for two-way communication. Approved radio is MDS Transnet 900.

8) A 4-20 mA temperature transmitter must be installed within the SCADA enclosure and be wired to the PLC analog input board for internal panel temperature monitoring. Temperature transmitter must be provided with RTD sensor and transmitter. Approved manufacturer is Freewave, Model FGR3-CE-U, or JCSUD-approved equal.

9) SCADA enclosure minimum dimensions shall be 36-inch wide by 48-inch high by 16-inch deep. Construction shall be white enameled stainless steel 304, rated NEMA 4X. All internal panel surfaces shall be insulated with 1-inch-thick semi-rigid foil-faced fiberglass insulating sheets, and be climate controlled by including both a 200-Watt minimum space heater and an A/C unit rated for 2,200 BTU @ 95ºF minimum and operating at 120 V ac. Approved manufacturer is McLean model T20-0216-G100, or JCSUD-approved equal. Design Engineer must exercise caution regarding the minimum required clearance around heater. Contact JCSUD for alternative to cool panel using louvers, filter, and mini exhaust fan motor in lieu of A/C unit, if permitted.

10) Tower used to mount the antenna shall be free stand type and design to withstand wind gusts of 90 MPH. The tower height will be determinate by the radio path study. Design Engineer will select the adequate tower and foundation according to the required height. Tower will be located

within lift station site in a place where maintenance vehicles have straight access. Drawings of the Tower Structure shall be submitted to JCSUD. Tower structure will be away from electric overhead wires. Minimum separation between tower and electric overhead will be 40 ft.

11) SCADA Panel will be provided with an uninterruptible power supply of 24 V dc. The power supply will provide reliable power for a minimum of 2 hours. Power supply will be used exclusively for the 24 V dc loads within the SCADA panel and pressure transmitter located in the header. The wet well level controller and any other 24 V dc load located within the Pump Control Panel and automatic transfer switch (if any) shall not be powered by the SCADA power supply.

12) Install a din rail mounted transient voltage surge protector and lightning arrestor inside the SCADA panel. Approved manufacturer is Citel, or JCSUD-approved equal.

13) Tower structure shall be grounded and indicated in drawings submitted to JCSUD. Ground resistance shall not exceed 5 Ohms.

2.3.10 Drawing Requirements

A) The construction plans shall include the following information:
B) Site layout showing boundaries, grading, drainage, SWPP and platting/recording information.
C) A plan and profile view of the lift station and associated site piping.
D) A profile view of the control levels and settings.
E) Graphs showing the system curve and selected pump manufacturer's curves for each phase of the lift station.
F) Electrical single line diagram, wiring and control system schematics.
G) Structural, mechanical, civil and electrical details.

See the District's Standard drawings for typical requirements.

Section 3 - Plan Set Standards

These plan set standards apply to engineering plans for JCSUD funded projects.

3.1 Page Formatting

3.1.1 Cover Page Format

A) Vicinity Map
B) Project Location
C) JCSUD Logo
D) JCSUD's Board members
E) Revision Block

1. Containing the revision number, name of revision, and revision date

3.1.2 Title Block Format

A) Document Title
B) Page title
C) Company Logo
D) Revisions
E) Sheet number/Total
F) Scale
G) Project Number
H) The designer, drawn by, and check by

1. Names shall appear in the I.N.T initial format

3.1.3 General Notes

A) Notes shall be clear and concise. Contact Engineering Department for a copy of general notes.
B) This section shall include
    1. General Notes
    2. Water and Wastewater Notes
    3. Drainage Notes
    4. Electrical Notes
    5. Environmental Notes
    6. Legend
C) Sheet Index

1. The sheet number and sheet name

3.1.4 Date and Time Format

A) All dates mm/dd/yyyy format unless in a title
B) If the date is in a title, use Month yyyy format
C) If the time of the day is important use the 00:00 military time format

3.2 Layer Standards

3.2.1 Line Weights

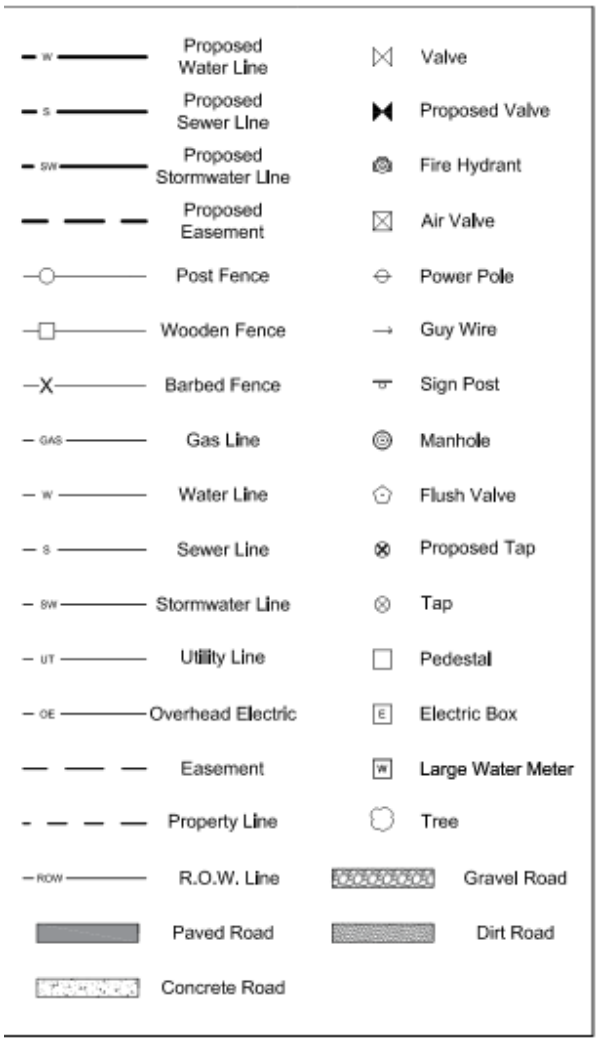
A) Area Boxes: 0.53

B) Border Lines: 0.53 (Neat Lines)
C) Detail Lines: 0.13
D) Fencing: 0.09
E) Property Lines: 0.30
F) Easements: 0.25
G) Existing Utility Lines: 0.20
H) Proposed Lines: 0.50
I) Topographic lines:
    1. Major: 0.13
    2. Minor: 0.05
    3. Proposed: 0.50
J) Section Lines:0.60

3.2.2 Line Type Standards

A) The JCSUD file is for reference, but other line types may be used if needed.
B) All line colors shall be legible in greyscale

Figure 1 - Line Weight Standards Example



3.3 Units and Fonts

3.3.1 Font Standards

A) All fonts must be Arial
B) Proposed textboxes and callouts shall have bold font. See **Figure 2** for reference.
C) Existing textboxes and callouts shall have non-bolded font. See **Figure 3** for reference

Figure 2 – Proposed Textbox and Callout Example

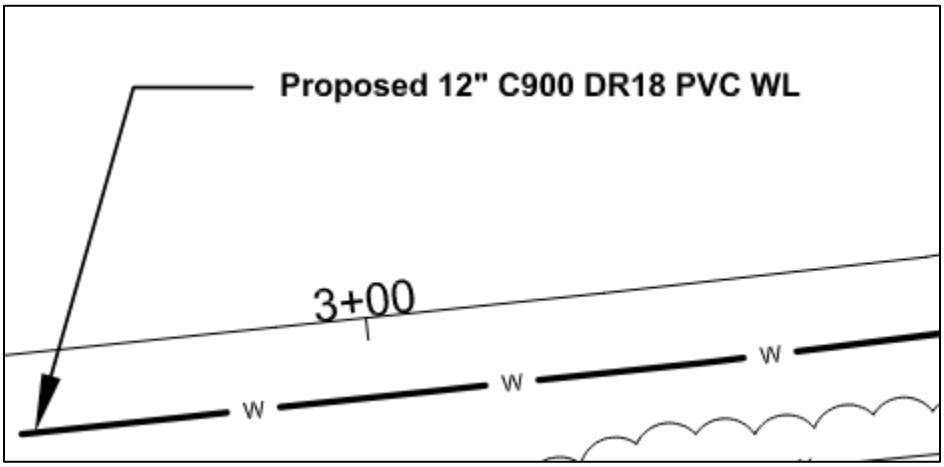
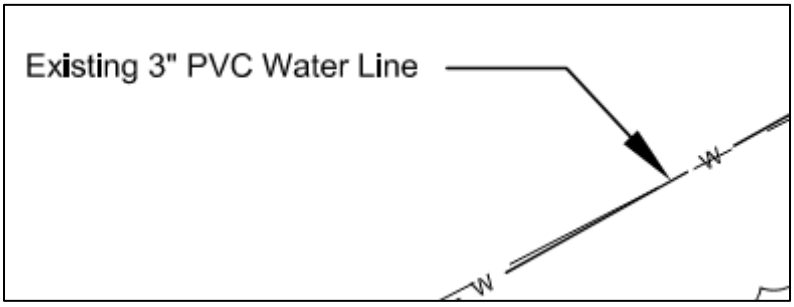


Figure 3 – Existing Textbox and Callout Example



3.3.2 Units

A) All Units must be in x' – x" format
    1. If either is 0, remove from the format
B) Units shall be in feet.

3.4 Shading

3.4.1 General

A) All roads and driveways shall be shaded
B) All road and driveway types will be shaded differently. See **Figure 1** for reference
    1. Gravel, dirt, paved, etc.

3.5 Textboxes and Callouts

3.5.1 General

A) Legible on an 11" x 17".
B) If the textbox is used on drawings or shading use a border.
C) All textboxes and callouts that require a border shall use a box.
D) Textboxes and callouts with revisions shall have a cloud border, and be appropriately numbered.
E) If a border line is used it shall be 0.05 line weight.
F) Background masks shall be used when placing callouts over shading, lines, etc.
    1. All textboxes shall have an offset factor of 1.5 – 2.0.
G) Text Frame shall be on.

3.6 Labeling

3.6.1 General

A) All fittings, tees, and other major appurtenances shall be labeled with the stations.
B) Valves and fittings shall be labeled with FL X Mj or Mj as required.
C) Stationing shall be in 100ft increments.

3.7 Other Notes

3.7.1 General

A) Plans must be submitted to the District in PDF and paper copy.
B) All plans must be in 11' x 17' format.
C) If Aerial photographs are used, the image must be free of all labels except labels placed by the design engineer within the drafting software.
D) All lines go behind labels.